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EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

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THE INTERSTATE TELEPHONE CONVENTION.

The convention of independent telephone men from the seven central states surrounding Chicago, held at that city last week, was an unusual success as to the number of interested exchange owners in attendance. The convention brought into existence a new organization, the Interstate Independent Telephone Association, composed of companies of the nine central states in which the independent telephone movement has been most active. This association is not intended to take the place of any present association, but to occupy a middle position between the state and national associations.

Earlier conventions have been largely devoted to the fight with the Bell companies, and in view of the bitterness of the struggle, participants in past conventions can be pardoned if it often happened that considerable time was devoted to relating the history of various encounters with the common enemy, and the application of choice epithets to Bell men and methods rather than to the more profitable questions of how to maintain a service and rates which would continue the popularity of the independent telephone exchanges. How to take care of the future development is the great question before the independent telephone companies to-day, and the discussions at Chicago show that this is being realized more than ever. Mr. L. A. Frazee expressed this well in his review of the telephone situation in Indiana, and what is true in Indiana is almost equally true in other states near-by. Mr. Frazee alleged in effect that the past problem was how to cope with Bell efforts to put the independent companies out of business, both by patent suits and by all conceivable business tactics. The present problem is how to conduct a largely increased business at a fair profit, for unlike other business the cost of telephone service increases with the number of subscribers. Then, too, there are the financial and engineering questions arising from the connection of numerous farmers' lines with town exchanges, and the connection of one exchange with another, the establishment of rates fair to all and the standardization of apparatus—the last by no means the least difficulty.

Speaking of farmers' lines, one thing that the convention papers served to emphasize was the important part independent telephony has played in giving rural districts the benefits of telephone service, and the entire lack of such service before the independent movement started. The figures given in Mr. Frazee's paper are even startling on this point; and the $100 offered for every farmers' telephone in use previous to 1894, cited by Mr. Conklin, still further emphasized the fact. At the same time, as pointed out by Mr. Rainey, the construction of cheap farmers' lines with poor material and poor instruments has tended to spread an impression that telephone service costs almost nothing, and this constitutes one of the greatest dangers that small independent telephone companies have to face.

Although the object of the convention was not, as some of the Chicago daily papers had previously announced, to form a consolidation of independent telephone companies, such gatherings may be regarded as stepping stones toward that end. While the accomplishment of such a consolidation is far too large a task to be accomplished by a hurriedly called convention, and for manifest reasons could not in any event be accomplished by such a gathering, it is nevertheless true that promiment members expressed themselves in no uncertain tone on the convention floor as to the desirability and probability of better traffic agreements and greater uniformity of

aims and methods, and even of absolute consolidation. If such consolidations do not come, it will be contrary to the present sentiment of the men interested, as well as contrary to the general tendency of the times. There will certainly be large groups of exchanges, under the "independent" flag. Such, indeed, exist already in many sections of the country.

THE RATIO OF TRANSFORMATION IN THREE-PHASE CIRCUITS.

Mr. Del Mar calls attention in an article this week to the changes in ratio of transformation that can attend the various methods of connecting sectional transformers with three-phase circuits. There does not seem to be much novelty in the algebra or numerics of the method of computation outlined. The resolution of deltas into their corresponding stars, or vice-versa, has been effected from time to time in our columns according to rigid rule; and it is only necessary to resolve all complex forms either according to an imaginary complete star, or according to an imaginary complete delta, and then apply the sectional ratio to find the total or net transformation ratio. The article, however, is instructive as showing the great variety of transformation ratios that such methods of connection render possible. It would be interesting, as a matter of curiosity, to compute the total number of possible ratios of which a given number of section transformers—say thirty—is susceptible. No doubt, the calculation would resolve itself into some branch of pure mathematics, such as "groups" or "quantics." It would give ample occupation to any computer who is yearning for work that has no immediate industrial utility.

THE AGE OF RECKLESS WASTE.

In a recent paper Prof. John Perry has sounded a note of warning against the ruthless waste of the world's fuel, for which future generations may have to pay a fearful price. Starting with the proposition that the normal value of energy is based on the value of human labor, he shows that when mankind, to save human labor, has spent its capital of stored energy, values must revert to the original basis, which in terms of our electrical units is not far from a dollar and a half per kilowatt hour. Whatever of economy has resulted from the use of steam is like the economy of one who keeps within his income by spending his principal. Sooner or later a day of reckoning must come—a time when the living will have to pay for the avarice of the dead. And unless some far reaching change in our methods comes to the rescue, this evil day will, in Prof. Perry's opinion, be upon the world not in some distant age, as unreal a phantom of the future as the epoch of the pyramid-builders is of the past, but even before the children of this century are come to see the dawn of the next. Great as is the store of fuel hidden under the surface of Old Earth, it is not infinite, and even the inroads of the last fifty years have brought the end within sight so far as the coal fields now known are concerned. Six or seven hundred million tons is the present yearly output of the world, and the demand grows with appalling rapidity. Deeper and deeper burrow the mines, and the labor of production steadily increases. Even now only our enormously developed systems of transportation keep the cost of fuel within bounds, and at the least touch of demoralization in these a fuel famine is upon us.

It is a serious situation even from the most optimistic standpoint. It is possible that modern civilization has been bought at so huge a price of terrestrial resources that it will fall a victim to its own immensity—die as the vast and terrible prehistoric monsters died, because the failing vegetation of the cooling globe could no longer furnish them food? Such a fate is not pleasant to contemplate, but it is upon the world's fuel that the world's industry now depends, and they must stand and fall together. In the century just ended, much was accomplished in economizing the fuel supply, but for every ton of coal saved ten more were demanded. The engines of a century ago required for each horse-power four or five times the coal now necessary for the same work, but in spite of this the output of coal has increased with prodigious rapidity. Something vastly more radical must be devised to bring the yearly consumption within bounds that may give a better outlook for the future. Prof. Perry looks to the direct transformation of the energy of coal into electric energy as a possible means of escape. If the world's latent power could be utilized at 90 per cent. efficiency instead of 10 per cent., there would result at least some centuries of respite. The task does not seem impossible, and yet the sum total of recent research is not encouraging, and the day of success seems afar off. The world's water powers form a reserve of which use cannot rob us, and which is as yet utilized only here and there in trivial amounts. But on the other hand, it is strictly limited in amount, and all the devices of modern power transmission cannot prevent dependence on water power shifting the world's centres of industry far from their present sites. Not all the syndicated powers of the world could save London or Paris or New York if water power held the key to industry. And the same insensate lust of gold that wastes our coal supply has denuded two continents of forest to an extent that seriously impairs the available water powers.

Perhaps a more promising remedy than either of those just noted lies in the direct utilization of solar heat, a problem of which the solution presents no formidable difficulties, and which has already been studied to some purpose. So prodigious is the world's annual income in solar energy that it could not be spent by any population that the earth could support. Even with our present wasteful heat engine, a hundred square feet of properly arranged mirror surface can be made to yield approximately a horse-power. The apparatus does not in any form yet devised lend itself readily to great concentration of energy in a small area, but it is singularly well suited to the development of those widely scattered industries which are a sure index of general prosperity. But the most striking characteristic of solar engines is the fact that they belong essentially to a climate of unbroken sunshine. If such is to be the world's refuge from the failure of fuel, it may be that the shades of centuries past will see again the streets of Thebes and Palmyra peopled with hurrying throngs and ringing with awakened industries. Even if the march of invention should greatly lessen the present waste of coal, even if the unexplored tropics should disclose unimagined wealth of coal fields, the steadily increasing cost of transportation will inexorably force industry near to its base of supplies. The population of the globe has been shifting its center of gravity since the beginning of time and will shift until the end. When the time comes in which the conditions of existence become hard in any given region, its population, slowly perhaps, but infallibly, drifts elsewhere. In the enormous waste of fuel going on from day to day, we see then not so much a vision of desperate struggle with hunger and cold as a sign of the enforced wandering that drove Norseman and Saxon southward and westward to conquer new continents, to develop their resources to the fullest, and then if need be to turn again over the seas and over land to work out with strong hands their restless destiny.

Prof. Perry makes an interesting suggestion apropos of a proposition, originally offered by Kelvin, that any great improvement in the thermo-dynamic engine—for example, a steam-engine—might enable local heating to be obtained more cheaply by engine than by direct fuel consumption. That is to say, just as in existing refrigerating plants, their apparent efficiency, with existing steam-engines, may be 400 per cent., reckoned on the basis of heat transferred per heat-unit of energy consumed in coal; so it might be

possible to have one potential-heat-unit in coal transfer 50 or 100 heat-units from out-of-door temperatures to living-room temperatures. Prof. Perry suggests that a few millions of dollars should be entrusted to such scientific leaders as Kelvin or Rayleigh, to expend upon the problem of improving the heat-engine, in order to realize a solution that would be an enormous benefit to mankind, and which would pay handsomely upon the expense as an investment.

The Genesis of Hertzian Telegraphy.

In these strenuous days when the wanton slaughter of man is glorified, and when dynasties and political parties strive to fan the embers of racial hatred to the heat of ruder ages, we cannot be surprised that even science becomes a field for controversy based, not upon facts, but upon prejudice. For some time the newspaper press has almost daily reported incidents in a warfare over priority in the invention of wireless telegraphy which, from the part nationality has been made to play, is strikingly illustrative of the uncivilized spirit to which we refer. One claimant is reported to have secured the support of his Emperor in his contentions; and a friend of another sneers at the "Italian" and the "German Professor" for their temerity in advancing claims in conflict with the "Englishman who was first in the field." The bitterness of the controversy has reached a point where, for the sake of decency, a halt should be called, particularly as the warfare appears, from the manner in which patents are flourished, to be a mercenary one instead of in the interests of scientific chronology. The matter has, in fact, ripened for the courts, and the sooner it is brought up for legal adjudication, the better, that the public may be spared an indefinite continuation of the present clamor. In the meantime we venture to present a few observations on the genesis of signalling by etheric waves as distinguished from signalling by means of electrostatic and electromagnetic disturbances.

If any name is to be associated with the designation of wireless telegraphy it is that of Hertz; for he was the first to demonstrate experimentally the existence of electric waves, and the first to devise means for their detection. By far, however, the greatest step in actual wireless telegraphy was taken when the filings electric wave detector was discovered. This discovery was independently made, first by Prof. Onesti in 1884, and, second, by Prof. Branly in 1890. Prof. Onesti's detector consisted of a small glass tube filled with copper filings, enclosed by two rings of brass and so mounted that it could be revolved. He showed that certain electrical disturbances had the effect of decreasing the resistance of the filings circuit, and that the original resistance could be restored by moving the tube so as to cause a rearrangement of the filings. The Italian Professor does not appear to have gone beyond a mere observation of the above facts, nor does he appear to have clearly understood the nature of the acting electrical disturbance. In November, 1890, Prof. Branly read a paper before the French Academy of Sciences, and printed in the *Comptes Rendus,* in which he described the coherer as it exists to-day, and it was from this description that the art of wireless telegraphy dates. As in the case of Onesti, an insulating tube was used containing filings between two electrodes. Prof. Branly found that the effect of a spark from an induction coil 20 meters distant reduces the resistance of the filings from several million ohms to as low as 100 ohms. He also stated that the original resistance could be restored by light blows on the base supporting the tube.

Crookes in 1892 put forth a speculation in which he anticipated in a remarkable manner the later development of wireless telegraphy. Hertzian rays, he said, could be received "on a properly constituted instrument, and by concerted signals messages in the Morse code can thus pass from one operator to another." He also very clearly enunciated the principles of syntonic wireless telegraphy. Had Crookes known of the Branly tube, the art of wireless telegraphy might have had its beginning at that date. In 1894, Lodge constructed an arrangement consisting of an electric bell connected with a relay, the relay being in circuit with a Branly tube, which latter Lodge called a coherer. With this he signalled over 40 yards, but suggested that "something more like half a mile was nearer the limit of sensitiveness." It was presumably on this experiment, which appears to have had no influence on the development of wireless telegraphy, that claims are based, assigning to Lodge not only the invention of the art, but also of the Branly tube. In connection with this latter claim, Branly, in a communication to the French Academy of Sciences on Jan. 6 of the present year, quotes from a letter written by Lodge, dated Jan. 8, 1899, in which the latter disclaims "any part in the discovery made by Branly in 1890 on the action exercised at a distance of electric sparks on metallic filings." The first practical application of the Branly tube appears to have been suggested by Popoff in 1895, in connection with meteorological observations. His arrangement of apparatus is in some respects very similar to that employed later by Marconi. The tube at one end was connected with a long antenna, and at the other to the earth. To the tube was connected a Richards recorder for the registration of atmospheric discharges, and a relay in the tube circuit controlled a tapping hammer.

We come now to the work of Marconi, which had its origin in Italy in 1895, but soon after was transferred to England. The vast and rapid strides that Marconi made from his first public English exhibition in 1896, when signals were transmitted 100 yards through intervening walls, to his recent Trans-Atlantic feat, are so familiar that no account need here be given. The first Marconi patent was applied for, June 2, 1896, and a consideration of this will show the advance over his predecessors—an advance which was, in fact, the creation of the art of non-syntonic wireless telegraphy as it exists to-day. This patent described the use of antennae at both stations, the construction in detail of a transmitter particularly adapted to its purpose, the construction in detail of a Branly tube of extreme sensitiveness, the proper arrangement of the coherer, tapping and relay circuits, and of the transmitting and telegraphic circuits. In other words, his work was comparable to that of Edison in producing, in 1880, a complete practical system of incandescent lighting from elements, some new, but mostly old, their commercial co-ordination involving practical inventive ability of the highest order. Since then Marconi has added numerous other improvements to the system, the most important of which is the "jigger," or inductive relation between the tube and antenna.

The controversy over the invention of wireless telegraphy has been conducted in such vague terms that the public could not otherwise than conclude that credit for every part of the invention was denied to Marconi and claimed by others. In point of fact, though apparently the claimants would deprive Marconi in the eyes of the public, of all credit, yet the contentions of the two principal claimants relate specifically to the invention of syntonic telegraphy; and the patents which have been flourished and the experiments adduced relate specifically to the syntonic feature, and in date are subsequent to the date of issue of the fundamental Marconi patent. As Marconi has not disclosed the details of his system of syntonic telegraphy, we leave this branch of the subject for such a time when all the facts will be at hand upon which to base an opinion as to the priority and relative credit of the several claimants. Whatever may be the issue with respect to syntonism, the credit will remain to Marconi of having created the art, unless better evidence can be produced to deprive him of it.

Three-Phase Four-Wire Systems.

Mr. Peter Junkersfeld, assistant to the mechanical enngineer of the Chicago Edison Company, read a paper before the Chicago Electrical Association, April 4th, on the "Application of four-wire three-phase systems in reconstructing and modernizing central stations." The Chicago Edison Company was one of the first to adopt this method of primary high-tension distribution for its outlying districts. The voltage used on this system is 4,000 between any two outside legs of the three-phase circuit. A fourth or neutral wire is run, which gives 2,300 volts between any of the outside wires and the neutral. When large motors are to be run, the transformers for the motors are connected delta-fashion to the outside legs of the circuit; the distribution, as far as the motors are concerned, is, therefore, 4,000 volts. For lighting circuits the three 2,300-volt single-phase circuits offered by the Y-connected three-phase system are utilized. The various single-phase lighting feeders are balanced between the three legs of the circuit. The distribution of these single-phase light circuits among the three-phase is done at substations, at which each lighting-feeder is provided by switches, whereby it can be thrown onto different phases. The system has the advantage of giving the standard voltage for alternating-current single-phase lighting, while at the same time supplying larger motors at a higher voltage. Motors of less than five horse-power, when not starting under load, are of the single-phase type. It has not been found difficult to maintain a balance between the three legs of the circuit.

The Annual Convention of the Iowa Electrical Association.

The Iowa Electrical Association held its annual convention April 9 and 10, 1902, at the Grand Hotel, Cedar Rapids, Iowa. This association has never had the publicity given to some similar organizations of equal size, but it is doubtful if any state electric light organization equals it in the amount of solid and beneficial work done. At this last convention 57 central station men were present. The entire time during the two days, evenings excepted, was given over to business.

The first morning was taken up largely with the report of the secretary, W. B. Keffer, of Des Moines. This report went very fully into the various items which go to make up the expense and income accounts of plants in different parts of the state. These items, including costs of coal, meter rates and other contract prices received for light, formed a document which will be published for the use of the members of the association.

Mr. Higley, of Burlington, read a paper on the "Relative Merits of Open and Enclosed Arc Lamps and the Relative Merits of Direct Current and Alternating Current Enclosed Series Lamps." This paper was discussed at length by Mr. J. G. Pomeroy, of Chicago, who took a stand in favor of the direct current series enclosed arc as against the alternating current series enclosed arc, on account of the greater amount of light below the horizontal plane, the longer life of carbons and the simple mechanism.

Mr. I. B. Smith, superintendent of the Cedar Rapids Electric Light and Power Company, presented a paper on the "Analysis of the Cost of Supplying of Electric Current." This paper was in the shape of a recommended form of classifying accounts, and was printed for the use of the members.

Mr. D. F. McGee, of Red Oak, gave a paper on "Free Lamp Renewals." All of these papers will be printed for the benefit of the members.

Mr. Murray C. Beebe, chemist of Nernst Lamp Company, lectured Thursday evening on the Nernst lamp, and Mr. W. J. Greene, manager of the Cedar Rapids Electric Light and Power Company, gave a smoker at the Grand Hotel on Wednesday evening.

Among other business transacted by the association was the appointment of Royal H. Holbrook, superintendent of the Ottumwa Traction and Light Company, a committee of one to determine the relative evaporation value of different kinds of Iowa coal. The selection is an excellent one, as Mr. Holbrook is an engineer, fully competent to carry out unprejudiced and thorough tests, and to make a report which will be of much practical value.

Supply men were not numerous at the convention, but among those present were J. G. Pomeroy, of the Adams-Bagnall Electric Company; Mr. Monroe, of the General Electric Company; Mr. Pinkard, of the Westinghouse Electric and Manufacturing Company, Mr. H. H. Coughlan, of the Manhattan Electric Company; Messrs. Millard and Towner, of the Electric Appliance Company; Messrs; Switzer and Mason, of the Central Electric Company; Mr. McNeal, of the Illinois Electric Company, and C. L. Ethridge, of the Evans-Almirall Company. Mr. Pomeroy, who took a prominent part in the arc lamp discussion, feels especially at home at this association, as he was able to find only three central station men at the convention who had not become converted to his views on the arc lamp question sufficiently so that they were not using "A. B." arc lamps.

The following officers were elected for the coming year: W. J. Greene, Cedar Rapids, president; D. F. McGee, Red Oak, vice-president; W. S. Porter, Eldora, secretary; C. S. Carson, Iowa city, treasurer. The next meeting will be at Davenport.

Electrical Engineers of the Day—XLII.

AUGUSTUS TREADWELL, JR.

Augustus Treadwell, Jr., was born July 15, 1869, in Brooklyn, N. Y. He received his education at the Polytechnic Institute, Brooklyn, graduating therefrom in 1892 with the degree of B. L., upon presentation of a thesis, having for a subject the specific inductive capacity of dielectrics, in which a digest of the literature of the subject up to date was included as well as a critical comparison of the methods of measurement of the dielectric constant. In 1893

he received the degree of E. E. from the same institute, again presenting a thesis, the subject of which was hot wire ammeters and voltmeters and the emissivity for heat of wire of various substances.

After his graduation Mr. Treadwell spent one year at the Polytechnic as assistant to Dr. Samuel Sheldon, the professor in charge of the electrical engineering department, and during the latter's illness that year took his place at the Polytechnic and had charge of the various classes. He then spent considerable time in experimenting, particularly on storage batteries, of which latter branch he early made a specialty. In 1898 he published a book, "The Storage Battery," which is to-day recognized as the standard on the subject of storage batteries. He has also written several articles on the subject of the use of storage batteries, which have appeared in the various technical publications.

For about a year Mr. Treadwell occupied the position of assistant to Mr. Charles Blizard, manager of the New York office of the Electric Storage Battery Company, which position he left in 1899 to become the private secretary of the then president of the company, Mr. Isaac L. Rice, and which position he still occupies.

As a worker, Mr. Treadwell is conscientious and persevering. This is evidenced by the wealth of detail material to be found in his book upon the storage battery. Personally he is possessed of great executive ability and discretion, both of which qualities are essential in his position as private secretary to one who is engaged upon the development of problems of considerable commercial magnitude.

The Evolution of the Message Rate Telephone Service—II

(*Concluded.*)

BY HERBERT LAWS WEBB.

THE description in the issue of April 5 of the development of the New York message rate service mainly touched on what has been done for the moderate and average users of the telephone, but side by side with this evolution of the general rates and service has been developed a special class of service for the large user which has been successful from every point of view, improving the service for all concerned and vastly increasing its value to the user. I refer to the private branch exchange, which most telephone companies are now taking up, but which has nowhere been developed in such a remarkable manner as in New York. The private branch exchange was originally introduced to provide subscribers who made great demands on the service with a flexible and efficient method of handling any desired amount of traffic. Under flat rates a busy office would keep its line or lines always busy with outward calls, blocking inward traffic and making bad service for many subscribers. With a private branch exchange, consisting of a switchboard on the subscriber's premises to which are connected trunk lines running to the nearest central office, and extension stations placed in the various offices or departments requiring the service, it is obvious that a flexible system is provided, capable of handling efficiently any amount of telephone traffic. Originally designed for business needs only, the private branch exchange naturally affords an economical method of supplying service to large aggregations of small users, as in apartment houses and hotels. It is rare now for a large hotel or apartment house to be built in New York without including in its equipment a

FIG. 1.—EIGHTEENTH STREET TELEPHONE BUILDING, NEW YORK CITY.

private branch exchange, giving service to every tenant. The new Ansonia Hotel contracted the other day for a branch exchange to serve 360 stations.

An excellent feature of the private branch exchange, most useful in a business establishment, but an important money saver in a large hotel or apartment house, is that it gives a complete interior service as well as the exchange and long distance service. The main object of the system, of course, is to make the exchange service available at as many points as may be required in the same building, and the interior service is a by-product, as it were. To the hotel manager the interior service is an important gain, as it saves labor and vastly improves the service he supplies to his guests. Telephoning an order direct from the room to the office is so obvious a gain all round over the method of ringing for a boy to take the order that the point needs no elaboration.

The private branch exchange was introduced in 1896 and took some little time really to catch on, for the reason that the large users were naturally the most reluctant to abandon the flat rate and unlimited

FIG. 2.—EIGHTEENTH STREET EXCHANGE.

service. Gradually they were convinced that their excessive use of their lines was in reality working against their own interests in that it blocked incoming calls, which were probably of just as much value and importance to them as the outgoing calls that naturally got the right of way. The branch exchange, once established, is capable of expansion or contraction both in number of trunk lines and of extension stations; properly designed to suit the needs of the traffic to be handled it can cope efficiently with any amount of traffic. At the time the private branch exchange system was introduced, one of the greatest obstacles to a generally efficient service was the excessive use of single lines by very busy subscribers, which resulted in such numerous answers of "busy" to callers requiring connection with the overloaded lines that "busy" was in danger of becoming a by-word. A good deal of missionary work had to be done in getting the private branch exchange service established. Many subscribers would not believe they used the service so much or that they lost so many inward calls through constant outward use. Others did not think the improved facilities worth the cost, and very few had realized the important work the telephone service was doing for them or saw how its effectiveness could be improved by new methods. A few discerning ones did at once realize the great gain in flexibility of the branch exchange service and adopted it without hesitation, but the majority had to be canvassed and argued with, to be supplied with records of tests showing the numerous ineffective calls made for their telephones every day, and to be gradually converted to the use of a system that to-day they would not part with at any price. Without hesitation it may be said that the private branch exchange system has been the most potent factor in improving the efficiency of the telephone service, both for the individual subscriber using it and for the general user. It has largely reduced the "busy" trouble, which a few years ago threatened to become a serious evil on account of the high pressure at which things are run in New York. It has given every subscriber who adopted it a rapid, smooth-working and effective means of handling his telephone traffic, by which every user has the service immediately available and every incoming call goes direct to the person for whom it is intended. It has made the large subscriber realize as he never realized before the important part of his business machinery the telephone service is, and it has provided a means of making the service directly available at a most reasonable cost to the army of dwellers in apartment houses and sojourners in hotels that forms a large proportion of New York's active population.

The private branch exchange rates and facilities have undergone various changes and modifications since the service was introduced. The service in a way has been an evolution from the extension sta-

tion and auxiliary line. The earliest attempt at adding flexibility to the service was the connection of an extension station to the line. Then an auxiliary line, at a lower rate than the original line, was offered, and if the service was needed at several points two extension stations could be connected to each line, giving an arrangement of two lines with three stations on each. The two lines had separate numbers and the extension stations were, of course, not common to the two lines, but each permanently connected to one or the other. To connect the two lines and the four, five or six extension stations to a small switchboard so that any station can be connected to either line, and to give the two lines consecutive numbers in the main switchboard, so that an operator on getting a call for the first, and finding it busy, could try the second, makes a very much more flexible arrangement, giving far better and more convenient service than the two individual lines, each with its two or three stations.

This is the simplest form of private branch exchange, and from this modest equipment of two trunk lines with four or five extension stations, the branch exchanges now in use run up to imposing equipments, having switchboards of several positions serving systems of several hundred lines and stations. As noted above, a recent branch exchange contract calls for a system of 360 stations, and several of the large hotels now considering the adoption of branch exchange service will require systems of nearly 1000 stations. At the end of February, 1902, there were in service in Manhattan 2160 branch exchanges with an aggregate of 5952 lines and 22,072 stations. During the last twelve months 1036 branch exchanges with 2584 lines and 9227 stations were added to the system.

The rates for private branch exchange service at present in force are the result of a process of evolution similar to that which has produced the main tariff for direct and party line service. Practically every item in the branch exchange tariff has been reduced at various times, and certain charges, as for a supply line to furnish ringing current, have been abolished altogether. With the common battery system, it is necessary to provide feeders for supplying current for talking and for operating the relays and signals, and no charge is made for these lines, either. The branch exchange tariff as it stands to-day is as follows:

Item.	*Annual Rate.*
Local switchboard with telephone station	$36.00
Each trunk to the central office	36.00
Each extension station on the premises	12.00
The right to send 3600 local messages in one year	108.00

Additional local messages 4c. each, or $3.00 per hundred if contracted for in advance.

The extension station rate of $12 a year or $1 a month is the same

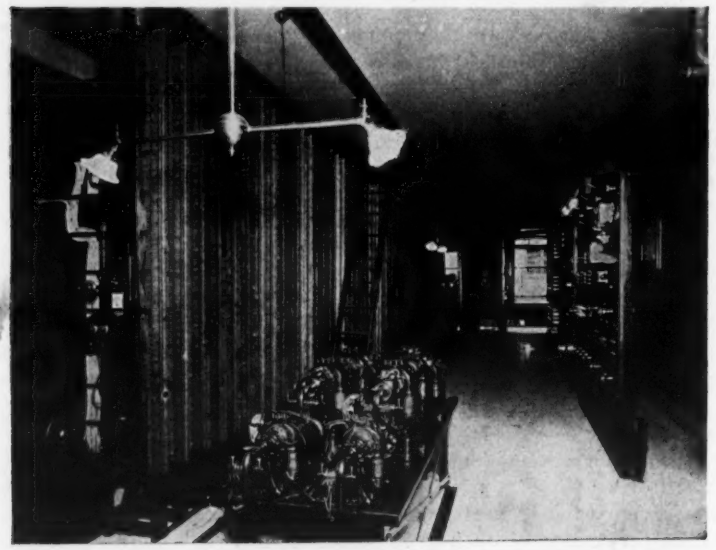


FIG. 3.—TERMINAL ROOM, EIGHTEENTH STREET EXCHANGE.

for both branch exchanges and for direct lines. To hotels and apartment houses, for which a special wall set, very compact and of neat and attractive appearance, has been designed, a discount is made on the extension station rate which eventually brings the rate down to an average of $8 a station when 120 or more stations are used. As with the other rates the extension station rate has been reduced by successive steps from the old flat rate of $60 a year to the present modest figure of $1 a month.

The extensive use of private branch exchanges leads to some curious results, and has certainly led to a much keener appreciation among business people of the usefulness of the telephone service than ever existed before. For example, among concerns that have several branch establishments in different parts of the city, the demand

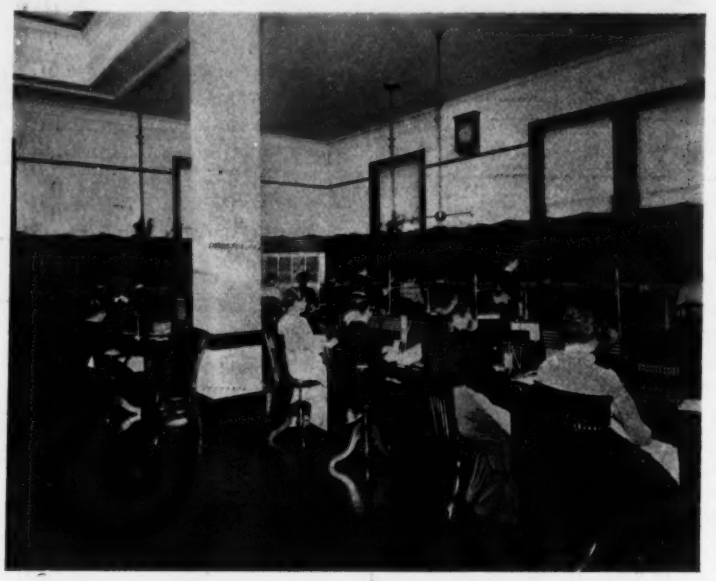


FIG. 4.—EIGHTEENTH STREET EXCHANGE.

naturally arose for private trunk lines connecting the branch exchanges in those different establishments. These lines are supplied and maintained by the telephone company, and there are now several large businesses, express and railway companies, having private branch exchange systems consisting of exchanges in different parts of the city, each connected to the nearest central office, but also connected together by direct trunk lines—practically a miniature reproduction of the main telephone system itself. The branch exchange system is capable of almost infinite ramification in this way. The Pennsylvania Railroad Company has a private branch exchange system which is a combined local and long distance system of no mean proportions, with branch exchanges in New York, in Philadelphia, in Pittsburg, Altoona, and various other towns along the line, all joined by direct trunk lines into one system, each branch exchange also having connection with the central offices of the town in which it is located.

Another curious feature of the popularity of the private branch exchange service is that there are now more telephone operators in private employ than there are in the employ of the telephone company itself. Not all of the 2200 private branch exchanges in service need an expert operator, as the smaller switchboards serving a limited number of lines and stations are generally put in charge of a stenographer or office boy. For these small exchanges cordless switchboards, in which the connections are made by means of cam-lever keys or dummy plugs, are generally supplied, as these are easy to operate and not likely to develop trouble from damaged cords, since they have none to get damaged. But in an exchange of any size, where the traffic is heavy, an expert operator is a necessity if good service is insisted on. Some subscribers make the mistake that the telephone companies did in the early days, and try boy operators. But the average boy is not intended by nature for a telephone operator, and his work is damaging both to the apparatus and to the temper of the telephone user. One of the bitterest diatribes against the shortcomings of the telephone service published of recent years in the editorial columns of a daily paper was indirectly inspired by the boy operator in charge of the private branch exchange of that paper. When a competent young woman operator was put in charge there was no more trouble with the service. In general, private branch exchange subscribers employ expert operators who have been graduated from the telephone company's ranks, and in this way, with expert operating at both ends of the line, good service is assured. In the Broad, Cortlandt, and John Street exchange districts, the private branch exchange operators outnumber the central office operators by about two to one. Uptown there is naturally not such a large proportion of branch exchanges, but taking Manhattan as a whole there

are considerably more private branch exchanges in service than there are employes in the whole traffic department of the company.

The development of the system described above has necessitated an enormous and very rapid increase in the plant. In 1894, when message rates were first adopted, the Manhattan system consisted of nine exchanges, Broad, Cortlandt, Franklin, Spring, Eighteenth, Thirty-eighth, Columbus, Seventy-ninth and Harlem. Of these, Broad, and Franklin were new, both having been put in service in that year, and Eighteenth Street had lately been rebuilt on the bridging system in a new building. Columbus and Seventy-ninth Street were comparatively insignificant exchanges, and Harlem was in process of reconstruction in a new building. At the present time there are thirteen exchanges, the four new ones being John Street, Madison Square, (East Twenty-ninth Street), Riverside (West Eighty-ninth Street) and Highbridge. In 1898 the change from magneto to common battery working was begun with the equipment of the Harlem exchange on the new system, which was put in operation in October of that year. The Riverside exchange was built from the beginning as a common battery exchange in a building erected specially for telephone purposes, and a similar building and equipment took the place of the old Seventy-ninth Street exchange, which was in leased quarters. The Madison Square exchange is in the same type of building as the two just mentioned. Columbus central office, on Fifty-eighth Street, just west of Ninth Avenue, is also in a modern telephone building, replacing the old small exchange in leased quarters in the same neighborhood. A new building has also been built for the Eighteenth Street exchange at Irving Place and Eighteenth Street. This exchange has rather an interesting record among telephone exchanges. It was originally at Twenty-first Street, and in 1889 the lines were transferred to a new central office in the building at the southwest corner of Broadway and Eighteenth Street. This office was equipped with a metallic circuit multiple board, the second of its type to be placed in New York, Cortlandt Street being the first.

FIG. 5.—COLUMBUS TELEPHONE BUILDING, WEST FIFTY-EIGHTH STREET.

The building seemed to have a fire hoodoo on it, as the exchange was twice in danger of burning down. In 1893 the exchange was transferred to a new bridging equipment in the fire-proof McIntyre building, on the opposite (northeast) corner, and in 1901, finally, "Eighteenth Street" brought up in the common battery exchange in the new building at Irving Place and Eighteenth Street. So that in a little over eleven years this exchange was rebuilt three times with a different style of equipment; probably a unique case, but strikingly illustrative of the rapid development of the telephonic art. The conversion to common battery working was completed with the opening of the new Cortlandt Street exchange in November, 1901; this office was fully described in recent articles in ELECTRICAL WORLD AND ENGINEER.

The construction of all these new exchanges, involving extensive alterations to the older telephone buildings and the establishment of several new ones, by no means represents all the work demanded by the rapid enlargement of the plant and the change in method of working during the past three years. The equipment of every subscriber's

FIG. 6.—COLUMBUS EXCHANGE.

station and of every private branch exchange has also had to be changed from magneto apparatus to common battery, and the installation of the new exchanges and of the many new stations has also involved a vast amount of new work on the cable plant. The distribution of telephone wires has now reached a fine art in New York City by the systematic development of the direct or block distribution method, another of the many improvements in telephone practice for which the industry at large is indebted to the New York Telephone Company. What the message rate system is to the business as a business, what the common battery is to the service proper, so the direct underground distribution system is to that very delicate portion of the plant—the subscribers' lines—a vast and far-reaching improvement. Briefly described, the method consists in carrying the main cables, now generally called feeders, into blocks of buildings and by means of distributing boxes or pot-head joints splitting up the wires into smaller cables, which in turn split up into yet smaller and so finally taper down to the pair of wires wanted at a given point. This results to all intents and purposes in carrying the subscriber's line in an underground cable, or at any rate in a lead-covered cable, the whole way from the terminal room in the central office to the subscriber's premises. The work was begun in a tentative way several years ago on a few down-town blocks, and it has progressed steadily so that now the method is in use in all parts of the city and more than 43,000 stations are at present connected by direct underground distribution. The gain in permanency of service is of course obvious, as the cables are free from almost any risk of damage except from fire, whereas the numerous risks that overhead distributing wires run are well known. There is also a gain in the time of connecting up a new subscriber or effecting a removal, as when a block is wired it is wired with a view to the probable future demand for telephones, and all the work then required to establish a new station is to run the inside wiring.

The thirteen exchanges at present in service have a total capacity of about 125,000 stations. Five more exchanges in Manhattan are at present planned for or in course of construction, "Orchard," on the lower East Side, which will serve a new district, relieving Franklin Street; "Chelsea," on West Seventeenth Street, which will relieve Eighteenth Street; "Plaza," on East Fifty-eighth Street, which will relieve Thirty-eighth and Seventy-ninth Streets, and two new exchanges in Harlem, one near the present exchange, and one on the west side of that thriving city within a city, to be named "Morningside." When these exchanges are completed the Manhattan plant will have a total ultimate capacity of about 225,000 stations, though this

figure is capable of considerable expansion without exceeding the limits of the switchboard capacity by reason of the growing use of private branch exchanges.

Across the Harlem River, northward, while the development has naturally not been so rapid as in Manhattan, on account of the difference in the population and business interests, still there has been a steady growth which has been nurtured and encouraged according to the same methods as those employed in Manhattan—the making of popular rates, the improvement of the plant and service and the systematic canvassing of the territory by direct work of agents and by advertising. The borough of the Bronx has its own contract office, reporting to the head contract office, but forming a local headquarters.

FIG. 7.—THIRTY-FOURTH STREET EXCHANGE.

In a short time, with the completion of the new Melrose exchange building, the Bronx will have its own telephone headquarters building, which will contain the new common battery exchange, a toll switchboard for working all the Westchester toll lines, and accommodation for the contract office and other working departments. The new Melrose exchange will have an ultimate capacity of 7200 lines. The other five exchanges in the Bronx have a total capacity of about 2700 stations, all except Tremont being quite small exchanges in districts at present sparsely settled.

Kingsbridge, Williamsbridge and City Island exchanges were established in such districts with a view to cheapening the service by cutting down the mileage rates formerly necessary in supplying service over the large area served by Tremont and Westchester central offices, both, like Melrose, situated near Third Avenue, the "backbone" of the Bronx. The Bronx has at present about 2000 telephones in use, and is making a steady gain of between 400 and 500 a year.

In the Westchester division, which consists of twenty-three exchanges in Westchester and Rockland counties, and one—Greenwich—in Connecticut, a similar campaign of development has been conducted, the plant having been almost entirely rebuilt and greatly enlarged, and various modifications in rates introduced. The public has made good response to these efforts, as the Westchester system has trebled in size in three years, increasing from 2400 stations at the beginning of 1899 to 7400 at the beginning of 1902. Underground wires have been used extensively in Westchester towns as well as in the Bronx, and towns like Mount Vernon, New Rochelle, Greenwich, White Plains, Yonkers, Tarrytown, Ossining and Nyack all have their underground systems of distribution. The principal centers, such as Mount Vernon, Yonkers and Tarrytown, are being provided with special telephone buildings; those at Mount Vernon and Tarrytown are completed and the new exchanges working, while the building at Yonkers, which will be equipped with a 3500 line common battery exchange, is nearing completion.

Since this article deals mainly with the development of the telephone service *per se*, and not with the technical details of the complex engineering and administrative problems that have had to be solved to keep pace with the very remarkable development record, it may be in order to say a few words on the purely business methods adopted to encourage the use of the telephone by the public. In New York direct canvassing and direct advertising were first applied to the telephone business. In 1893, when the contract department was first organized as a force to go out among the people and get new business, a radical departure was made from previous telephone business policy. The value of the work of an organized contract department, manned by agents specially chosen and trained to meet the public and discuss telephone service and rates in an intelligent manner was quickly apparent, and the department has grown year by year to its present large force.

Direct advertising was a little slower in being adopted, but it came naturally and in due course as a necessary part of the policy that regarded telephone service as something to be sold to the public in the same way as any other service or commodity. In advertising, as in other directions of telephone effort, the New York company has set the pace for telephone managers, and its advertising phrases are copied from Maine to California. The famous "Don't Travel, Telephone!" first saw the light on a column at the telephone exhibit in the electrical exhibition held at the Grand Central Palace in 1896. It has since gone wherever telephone service is used and English is spoken. The general principle of the advertising done for the telephone in New York has been to draw attention to the advantages of the telephone service by some such pointed phrase as the above, to proclaim the scope of the service by announcing the steadily growing number of stations in the system, and conspicuously to advertise the rates at which service is supplied. If you tell a man not to travel, but to telephone, that "telephoning typifies time saving," that the telephone service puts the whole organization of a city at his command, and so on, you make him think; when you tell him that there are 75,000 telephones in service in New York you show him that there is a great and far-reaching system of communication at his disposal, and when you tell him that he can have this service for $4 or for $5 a month, as the case may be, you make your case complete by showing him that that which is highly useful is also cheap. The newspaper advertising has been supplemented by a steady stream of circulars and booklets, attractively printed and illustrated, drawing attention to rate reductions and to special features and facilities of the service. These make a more direct appeal to the recipient, perhaps, than the newspaper advertisement, which does its work by reiteration; the two together have certainly been of great service in spreading among the people a knowledge of the usefulness, of the scope and of the cheapness of the telephone service. Any telephone company that gives a good service at reasonable rates is hiding its light under a bushel if it neglects systematic advertising.

Ratio of Transformation in Three-Phase Circuits.

BY WM. A. DEL MAR, A. C. G. I.

A SIMPLE formula for ascertaining the ratios of transformation attainable by the use of various combinations of transformers is here proved, and may be found useful by those engaged in work on three-phase currents.

The coils of transformers are usually built in several sections, as shown in Fig. 1, in order to facilitate a change of ratio, but a number of one-section transformers gives the same result. As the terms

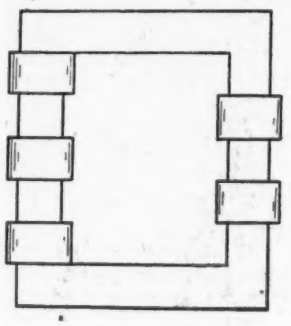


FIG. 1.—COILS OF TRANSFORMERS.

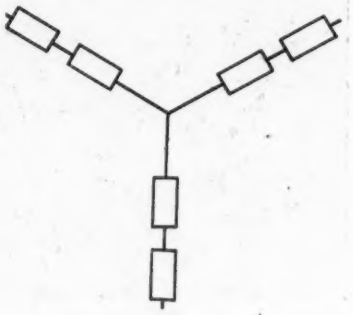


FIG. 2.—STAR CONNECTIONS.

"primary" and "secondary" might introduce confusion on account of their interchangeability, the expressions high and low tension will be used and abbreviated to *H. T.* and *L. T.*, respectively. The difference of potentials (*P. D.*) at the *H. T.* and *L. T.* terminal of a combination of transformers will be designated as the *H. T.* and *L. T.* line *P. D.*, respectively.

The three arms carrying currents in different phases may be connected in star, as shown in Figs. 2 and 4, in delta as shown in Fig. 3, or

in a combination of star and delta, such as shown in Figs. 5 and 6. This last case being a general one, it will be considered in detail. As the number of sections in multiple does not affect the potential of a balanced combination, only those in series need be considered, so that if they are quite similar, the drop of potential is the same in each. Let it be v volts in the *L. T.* and $n\ v$ volts in the *H. T.* sections. First consider the *L. T.* side. If there are d sections in series in each arm of the delta, the drop of potential in one of these arms will be $v\ d$; and if y be the number of sections in series in each arm of the star, the drop of potential in each of these arms will be $v\ y$. This is true of any of the three arms of the star, so that as the *P. D's.* between the ends of the arms differ

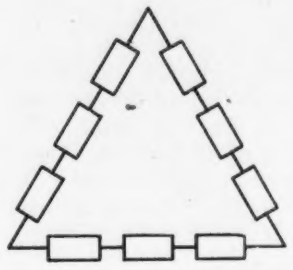


FIG. 3.—DELTA CONNECTIONS.

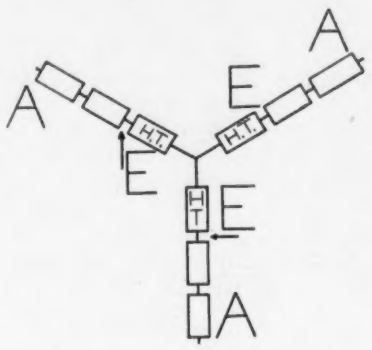


FIG. 4.—STAR CONNECTIONS.

in phase 120 degrees, the sum of the drops of potential in any two arms is $\sqrt{3}$ times that in one arm; that is, $v\ y\sqrt{3}$ From this it follows that the *L. T.* line *P. D.* or the sum of the drops of potential along two arms of the star and one arm of the delta, is $v\ y\sqrt{3} + v\ d$ or $v\ (y\ \sqrt{3} + d)$.

If corresponding capital letters be used to denote the corresponding number of sections on the *H. T.* side, the *H. T.* line *P. D.* will be $n\ v\ (Y\sqrt{3} + D)$. Hence the ratio of transformation, or

$$\frac{H.\ T.\ line\ P.\ D.}{L.\ T.\ line\ P.\ D.} = \frac{Y\sqrt{3} + D}{y\sqrt{3} + d}$$

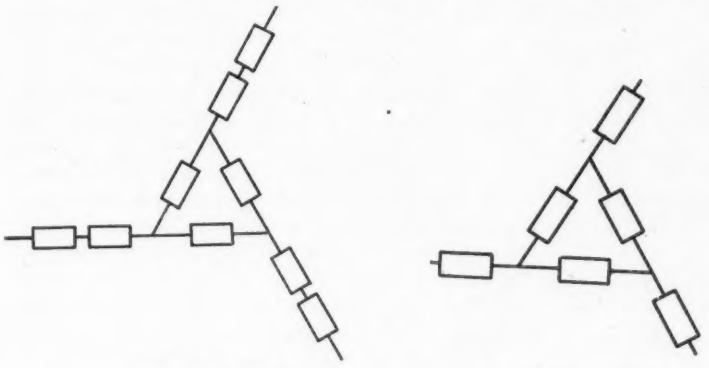
Consider the case of a transformer having two *L. T.* and three *H. T.* sections, the ratio from section to section being 5 to 1. If the *H. T.* coils be arranged as shown in Fig. 5 and the *L. T.* coils as shown in Fig. 6, $y = 1$, $d = 1$, $Y = 2$, $D = 1$, $n = 5$, so that

$$\text{ratio} = 5\ \frac{2\sqrt{3}+1}{\sqrt{3}+1} = \frac{22.3}{2.73}$$

If the *H. T.* sections be arranged as shown in Fig. 3 and the *L. T.* sections as shown in Fig. 2, $y = 2$, $d = 0$, $Y = 0$, $D = 3$, and $n = 5$, so that

$$\text{ratio} = 5\ \frac{3}{2\sqrt{3}} = \frac{15}{3.46}$$

When the high and low-tension sections are connected together,



FIGS. 5 AND 6.—COMBINATION STAR AND DELTA CONNECTIONS.

arrangements such as that shown in Fig. 4, are obtained. In this case as in the last, line *P. D.* $= (y\sqrt{3} + d)\ v$, if only the *L. T.* sections are used. Now the *H. T.* sections each produces the same drop of potential as n *L. T.* sections. Hence, if both sets of sections are used, the line *P. D.* $= v\ [(y + n\ Y)\sqrt{3} + (d + D)]$.

If such a combination be tapped at three symmetrical points nearer the center, the *P. D.* between these points may be obtained from the above formula if the quantities y, d, Y, D, are taken to designate the number of sections between the center of the combination and the points in question. An example of this is shown in Fig. 4. The *P. D.* between the points *A A A* is

$$(2 + 5)\sqrt{3}\ v$$

because $y = 2$, $Y = 1$, and $n = 5$, while the *P. D.* between the points *E, E, E,* is

$$5\sqrt{3}\ v:$$

as $y = 0$, $d = 0$, $Y = 1$, $D = 0$, and $n = 5$. Hence the ratio of transformation is,

$$\frac{7\sqrt{3}}{5\sqrt{3}} = \frac{7}{5} = 1.4$$

A special case of this formula, namely that in which the *L. T.* and *H. T.* sections form simple stars and deltas, has long been used in the testing department of one of the great manufacturing concerns; but the ratios for compounds of stars and deltas are there calculated graphically. The simplicity and accuracy of this algebraic method recommends it as superior to the graphical method.

The Economic Design and Management of Telephone Exchanges—X.

BY ARTHUR V. ABBOTT, C. E.

THE RELATION BETWEEN SUBSCRIBERS' DISTRIBUTION AND WIRE MILEAGE.

ATTENTION has already been directed to the effect of the distribution of the subscribers on the location of the central office, and it is now necessary to consider, in addition to the shape of the group of sub-stations tributary to the office in question, the density of the group, or the number of sub-stations, per unit of

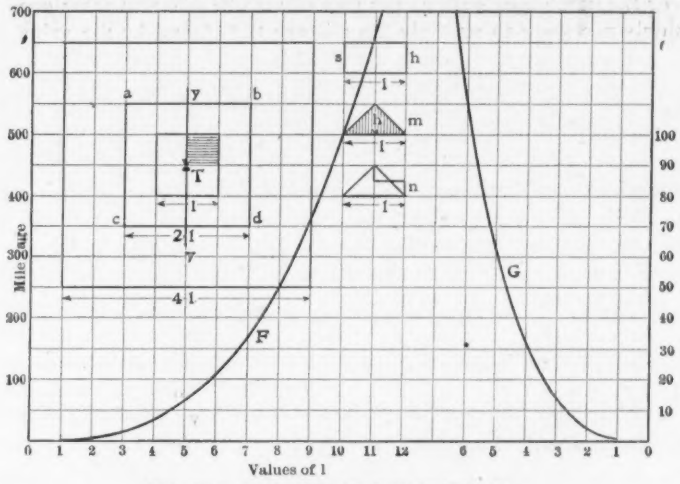


FIG. 21.—GROUPING OF SUB-STATIONS.

area; the way in which changes in density affect the cost of installation, and the complete relation between the shape of the group, its density and the necessary wire mileage to reach all stations. The simplest case is that of a group of regular geometrical section, such as a square, or circle, over which the sub-stations are distributed in uniform and regular order. Unfortunately, such a group never occurs in practice, but even the most heterogeneous arrangement may, by differentiation, be split up into sensibly uniform parts, and the results of reasoning applied to each differential will, when integrated, supply a solution for the whole area. Referring to Fig. 21, suppose the territory under consideration to be represented by the square *a b c d*, over which the stations are uniformly distributed. Let l be the length of one side of the square, then the area will be l^2, and if there are S stations per unit of area, the total stations will be Sl^2. The telephonic center will evidently be at the geometrical center of the figure, and as all stations are brought to the office by rectangular routes the best wire plant system will consist in building a main lead along a diameter of the area passing through the office, say, at *y y*, and bringing to this main lead all the sub-station lines, as shown by light black lines in the upper right-hand quadrant, and then carrying them to the office along the main lead. If l be the side of the square, it is evident by inspection that the average distance of all the stations from the main lead is $\frac{l}{4}$, and the average length of each line along the main lead is also $\frac{l}{4}$, hence the average distance of all sta-

tions from the office is $\frac{l}{2}$, and the total distance or circuit mileage of all stations is $S l^2 \times \frac{l}{2} = \frac{S l^3}{2}$. For metallic circuits the wire mileage will be double the circuit mileage or $S l^3$, thus giving a very simple expression for the total wire mileage or *lineage*, as this quantity may for brevity be called in cases of the kind.

If a plane be imagined to be passed along $y\,y$, the distribution of sub-stations will be represented by the projection of this plane on the plane of the paper as shown at H, in which S represents to scale the sub-stations per unit of area and l the length of the section of the group. Suppose now the group to increase in size until l becomes $2\,l$, $4\,l$, etc., the area will be 4 times, 16 times, etc., as large as the orginal area, then the successive total circuit mileages will be found (by substituting $2\,l$, $4\,l$, etc., for l) to be $4\,S\,l^3$, $32\,S\,l^3$, etc., but in each of these expressions l is the length of the side of the original plot. As S or the number of stations per unit of area is a factor of the first power in the expression, any change in the station density will simply make a pro rata change in the wire mileage. The curve F given in Fig. 21 gives the relation between the total circuit mileage and the size of the territory covered. The vertical and horizontal scales must be read in the same units, thus if l is taken in miles, then the left-hand scale giving the circuit mileage must be read in miles, and the station density is to be taken in the same unit squared. For example, suppose a certain territory to be two miles square and to contain one subscriber per square mile, then from the curve four circuit miles or eight wire miles will be needed to reach these stations. Assume another group four 1000 ft. on a side, with one station per 1000 ft. square, then the circuit mileage will be 32×1000 ft., or about six miles, and the wire mileage about 12 miles. If S or the number of stations per unit of area be different from one, it is only necessary to multiply the mileage thus found by the value of S. Thus in the preceding example, suppose S to have a value of 5 per 1000 ft. square, then the needed circuit mileage will be $32 \times 1000 \times 5$, or about 30 miles. At the right hand of the sheet the curve G is a portion of the lower part of the curve F magnified five times for convenience in reading small value of circuit mileage.

Suppose now the shape of the group is that of a rectangle the sides of which are a units and b units, respectively, then the area will be $a\,b$ and the total number of stations $S\,a\,b$. If the main lead is built parallel to the side a, then the average circuit distance to the main lead will be $\frac{b}{4}$ and the average length of circuit along the lead $\frac{a}{4}$. The total circuit mileage will be $S\,a\,b\left(\frac{a+b}{4}\right)$ and the wire mileage $S\,a\,b\left(\frac{a+b}{2}\right)$. An expression of the same value is easily found if the main lead is built parallel to the side b, showing that either diameter may be used indifferently to give the same total wire mileage. An extension of the same reasoning may be applied to a group of any shape, though those which are, or those which approximate to the well-known geometrical forms, are easiest dealt with.

So far the reasoning has proceeded on the assumption that the density of the distribution of sub-stations was uniform over all the area under consideration. But this condition rarely if ever obtains, on the contrary, station density per unit of area is usually greatest near the telephonic center, and decreases with greater or less regularity towards the perimeter of the area. To consider the effect of a varying density return to Fig. 21, and again consider the square $a\,b\,c\,d$ to be the territory under consideration, but suppose the density to be a maximum of, say, h at the point T and to decrease regularly to the bounding lines in all directions. Imagine now, for the sake of obtaining a clear mental picture, that the stations are piled on top of each other all over $a\,b\,c\,d$ in proportion to the assumed density. This will give a solid of the shape of a regular four-sided pyramid, of which the base is the area $a\,b\,c\,d$ and the altitude is h, or the maximum station density. If a plane be passed along y, the section of the pyramid will be a triangle with a base l and an altitude h. The vertical lines or ordinates to the base l shown at m (Fig. 21), represent the varying station density, while the horizontal lines or abscissæ to the altitude of this triangle are proportional to the circuit mileage required to reach the several clumps of stations that make up the entire group and the product of all the ordinates and abscissæ will be proportional to the circuit mileage required to bring the stations to the office, or, in other words, to the area of the triangle. But this area is equal to that of a rectangle of the same base and half the altitude, hence it is proper to replace a non-uniform distribution by a uniform one of the same base and a proportional altitude and calculate lineage by the preceding method. So all forms or densities of sub-station groups may be reduced to equivalent simple areas and densities and considered accordingly.

The slightest inspection of the curves of Fig. 21 shows that the necessary lineage to reach sub-stations increases very rapidly as the size of the territory tributary to any office is augmented, the formula for mileage showing the ratio to be proportional to the cube of the side of the territory, and directly proportional to the station density. In formulating, therefore, the design of any telephone plant, the present and future, station density, and present and future area to be served must be carefully considered separately from each other. If further future growth is to take place by increments in density, the wire plant expense will increase pro rata with the density, while if growth in territory be anticipated, the wire plant cost will grow as the cube of the side of the original area. Ordinarily it is probable that there will be both an increase in station density and territorial expansion, though as telephone companies usually work within well defined boundaries, specified by franchise grants, such as town or city limits, the ultimate available territory is usually well defined and grows very slowly, only as fast as corporate limits are extended, yet it is rarely that a telephone company plans at its start to cover all territory included in its franchise.

THE AVERAGE LENGTH OF LINE.

If in any territory the total circuit mileage needed to reach all sub-stations be divided by the total number of stations a quantity is obtained that represents the *average circuit mileage* of each station from the office, or the average distance of all sub-stations. For a square group with uniform distribution the average mileage is by the previous discussion $\frac{l}{2}$, for a rectangle $\frac{a+b}{4}$. For all non-uniform station densities, the average mileage will be less than the preceding expressions, except in the extraordinary case of a density greater at the perimeter than at the center. Though average mileage is an implicit function of density and size of territory, its dimensions do not convey the slightest idea of either of these quantities, for a small exchange with low density may yield an average mileage either greater or less than a much larger one with greater density. While a theoretical investigation of total and average mileage is an interesting subject, the practical telephonist is usually more concerned in what *is* than as to *why* it is, and the actual determination of average mileage is an easy though somewhat laborious task. For an untelephoned town the most accurate possible estimate obtainable is made by plotting on a good map the location of probable sub-stations, and then making measurements, following streets, from the office site to all stations. As, however, a large number of cities possess telephone plants it is easy, by plotting from the telephone directory the location of all sub-stations, to calculate the average existing mileage with great accuracy. By thus tabulating from a large number of cities a valuable collection of data may be gained from which it is possible to prophesy with more or less accuracy the probable average mileage in a similar untelephoned town. There are, however, at present two perturbing influences, which should cause deductions from such source of information to be received and used with the greatest caution. The first of these disturbing causes lies in the rapid increase in the number of subscribers to all existing telephone plants. This increase arises partly from the natural growth of the business, partly from unprecedented prosperity and business activity in the whole country, but at present chiefly from a keen competition that stimulates all telephone companies to secure as many subscribers as possible, by all means in their power, thus incidentally lowering telephone rentals and bringing service within the reach of many who otherwise would not subscribe. From these causes it is safe to estimate that within ten years past the telephonic population of American cities has more than quintupled. The general effect of this increase in sub-stations is to decrease the average length of line, though this decrease is by no means proportional to the rate of increase in numbers. For with a diminishing telephone tariff, there is a tendency to build up the station density about the perimeter of the territory inhabited by the less wealthy classes, much more rapidly than in the center, where the converse holds true. Again, in many cities two competing telephone companies are established. There are some who subscribe to one company, some to the other, and some to both. While as a matter of fact it is easy to determine the actual average length of line by dividing the total wire mileage

by the total number of sub-station instruments, such a deduction is misleading, as telephonically two instruments at the premises of one subscriber are superfluous. With these reservations the curves shown in Fig. 22 may be considered as approximate indications of the probable average length of line to be expected. It is convenient to divide these curves into three groups: Those that apply to large cities having a population over 500,000, those for medium cities with, say, 200,000 to 300,000 inhabitants, and those for small cities, having 100,000 inhabitants or less. The curves *a b* and *c* apply to the first group. On the lower horizontal scale the number of sub-stations included in the office will be found, while on the right-hand vertical scale the corresponding circuit mileage in tenths of a mile is given. The curve *a* refers to the central portion of a large city, curve *b* to a part midway between the center and the outskirts, and curve *c* to the outer portion. The curves are used as follows: Suppose it be desired to find the probable length of line in the middle portion of a large city for an office of 2500 subscribers. On the lower horizontal scale find 2500, then follow a vertical until the curve *b* is intersected, then a horizontal to the right-hand scale reading .705 miles. The curves *d*, *e* and *f* are similarly the data for the central, middle and outer portion of a medium-sized city, while the curve *g* applies to the center of a small city or a large town. To avoid confusion these curves are plotted to scales on the top and left hand of the sheet, which should be turned over to read the curves. It should not be forgotten, however, that these values apply only to *wire plant used*, and as a certain surplus must always be counted on, the curve

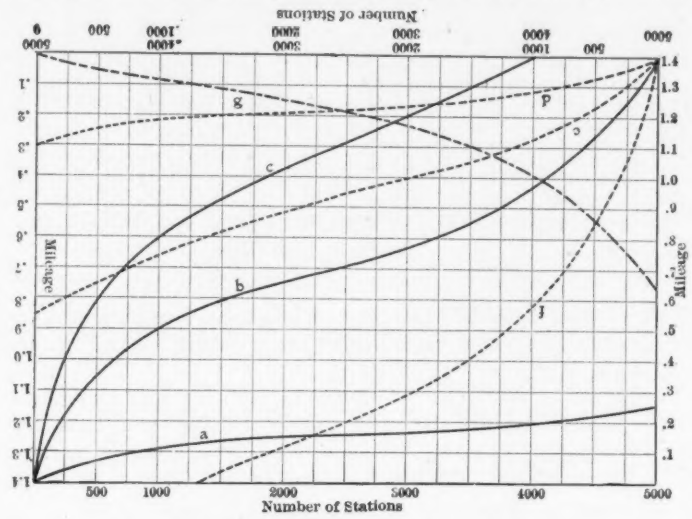


FIG. 22.—AVERAGE LENGTH OF LINE.

values must be multiplied by from 50 per cent to 100 per cent if they are used to indicate the probable plant necessary to install.

DECREASE IN LINEAGE BY SUB-DIVISION OF TERRITORY.

An inspection of the curves of Fig. 21 shows that if any given territory be sub-divided into several parts, and an office placed in each one, the sum of the wire mileage needed to serve all the stations in the sum of the parts, is much less than that required when the territory is treated as a whole tributary to one office. Thus, for example, a square territory divided into four parts will need one-half the mileage of the same area taken as a whole, and the question at once arises, why not sub-divide all territories into a large number of small offices? This at once introduces the great debatable ground in telephony, of one office versus many offices, over which the entire fraternity have from the beginning been divided into two opposing factions, and about which has been fought a long, wordy war, with here and there spits of bitterness, far more indicative of personal prejudice than of such a calm spirit of impartial evaluation of evidence as is demanded for the proper investigation of scientific or economic problems. Like many other controversies, however, this question resembles the old argument about the Druids Shield, for there are two entirely distinct, and totally different sides to it, and the controversants rarely take the pains to consider that the color of the other side may be entirely different from the one at which they are gazing.

There is on the one hand the economic or engineering aspect that considers only how to build and operate the best plant for the least money, while on the other is the standpoint of character of service rendered to the subscriber; a question belonging strictly to the general manager, being entirely foreign to the province of the engineer; unless, as is sometimes the case, a single individual attempts "Poo Bah" fashion to combine both offices. It is beyond cavil certainly that within reasonable limits the sub-division into several offices of a territory either containing a large number of stations or spread over a territory of considerable area, will decidedly cheapen both the cost of original construction and that of annual operation over the same territory designed on the one office plan. But it is equally *sure* that with this multiplicity of offices the *service* to the subscriber will be somewhat slower, and the percentage of errors increased. It is the province of the engineer to estimate as accurately as possible the probable cost of equipment and operation on both methods, and express an opinion as to the relative excellence of the service rendered by each. But here the engineering questions end, for it is purely a general manager's question to decide whether the difference in service is worth the cost thereof, and whether the finances of a particular company will permit the expenditure of the required difference in investment or annual expense. A precisely similar problem is presented in the determination of the kind of switchboard system to be employed. A well constructed magneto exchange is cheaper to install and maintain than a common battery system, but the service is not so pleasing nor effective. To telephonic engineering belongs the problem of estimating the relative cost of each, the determination of the kind of service each will give, and the successful installation of whichever system may be selected, in the cheapest possible manner consistent with good work. But the selection of the one to be used in a given instance is a general manager's problem, with which the engineer has nothing to do. In the succeeding paragraphs, therefore, it is proposed to detail the effect on cost of installation and operation of the sub-division of a given territory into several offices, and the effect of this sub-division on the service rendered, as compared with a single office, and leave the reader to form his own estimate of the relative value of these two incommensurable quantities—quality of service and cost of plant—for there is no common unit by which both can be measured, and this is the real root of all differences of opinion on this question. But first, however, it is necessary to exhibit the method of sub-dividing any territory into subordinate parts in such a manner as to demand the minimum wire mileage to reach all sub-stations in each division.

THE SUB-DIVISION OF A GIVEN TERRITORY IN ORDER TO MAKE SUB-STATION MILEAGE A MINIMUM.

In order that any territory may be divided into several subordinate parts such that the sum of the mileage in all the parts to their respective sub-stations shall be a minimum, two conditions must be fulfilled. These are:

Condition I.—The office in each division must be at the telephonic center of that particular division.

Condition II.—Each division line between each of the sub-divisions must bisect and be perpendicular to a line joining the telephonic centers of the two groups that it separates.

CONDITION I.

It has already been shown that for any arrangement of sub-stations a minimum mileage is secured by locating the office at the telephonic center. If any territory be sub-divided into a number of smaller parts, and the office of each part be located *away* from the telephonic center of that part, the mileage for this group will be greater than if the office be placed at the telephonic center. As the sum of all the parts can only be a minimum when each part is a minimum, it is only possible to secure this result by placing each office at the telephonic center of its own portion.

CONDITION II.

This condition requires that each division line between groups shall be perpendicular to, and bisect a line joining the telephonic centers of the adjacent groups. Let Fig. 23 represent any territory whatever with any distribution of sub-stations. Suppose this territory to be sub-divided into two parts, the telephonic centers of which are at A and B, and let $A\ B$ be any straight line joining these centers. Also let m_1 m_2 and m_3 be any sub-stations equidistant from $A\ B$. Let $a\ b$ be any division line drawn through the point midway between A and B. Then $A\ O + O\ m_1$ is equal to $B\ O + O\ m_1$ by construction and m_1 is equidistant from either A or B. Now, assume the line $a\ b$ to move in either direction to the points P or Q. Then $A\ O + O\ P + P\ m_3$ is greater than $B\ P + P\ m_3$ and $A\ Q + Q\ m_3$ is less than $B\ O + O\ Q + Q\ m_3$. Hence, any station to the right of $a\ b$ in its original position can be carried to B with less mileage than to A, and any one to the left can be carried to A with less mileage, also any station on

a b can be carried indifferently to either office with the same mileage; therefore, the division line must bisect *A B*. Suppose now the line *a b* to revolve about the point *O* till it intersects any station m_3, which is at the same distance from *A B* as the station m_1. Since m_3 is on the dividing line it is immaterial to which office it is carried, for $m_3 O + O A = m_3 O + O B$. But either $m_3 O + O A$, or $m_3 O + O B$ is greater than $m_1 O + O A$ or $m_1 O + O B$, hence the only line which passes through *O*, all of whose points are at a minimum distance from *A* and *B*, is one which is perpendicular to *A B*.

This demonstration has not recognized the condition that all stations must proceed, rectangularly to the co-ordinate axes, to their respective offices. So *Condition II.* must be modified to read that all points on the lines of division between adjacent districts must be *rectangularly* equidistant from the adjacent offices. For, in Fig. 24, let *A* and *B* be the telephonic centers of two divisions of any district. the lines of the paper standing for the street directions. Draw *A B* according to *Condition II.*, the division line separating the two parts of the territory must bisect and be perpendicular to *A B* at *O*. Stations, however, cannot reach *A* or *B*, save by routes that are parallel to *A D* or *A C*. Therefore, the shortest available distance connecting the offices is *A C B* or *A D B*. To determine the division line, therefore, it is necessary to bisect *A C B*, obtaining the point *H*, and

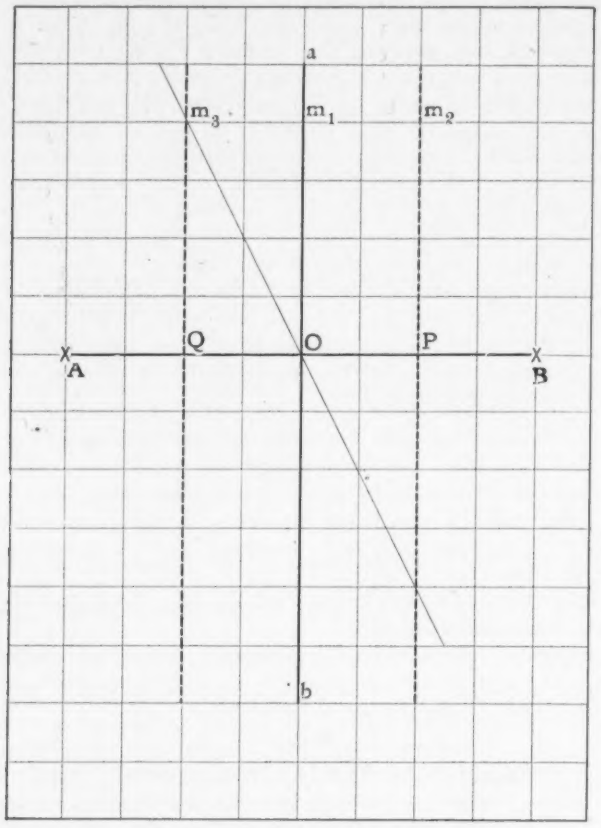


FIG. 23.—SUB-DIVISION OF TERRITORY.

A D B obtaining the point *I*, and to erect the perpendicular *H G* and *I K*. By inspection it is evident that all points on *G H O I K* are equidistant rectangularly from either *A* or *B*. Hence this line will be the true division line separating the two parts of the district. All stations on the line may with the same mileage go to either office while all stations to the left must proceed to *A* and those on the right to *B*.

This condition of rectangular measurements leads to a special case when the telephonic centers are so located that the separating line joining them is at 45 degs. with the co-ordinate axes. Refer to Fig. 25, in which *A* and *B* are the respective telephonic centers and *A B* the line joining them is 45 to the lines of the section paper representing the street directions. Then *f A e* and *f B e* are the shortest rectangular routes between the two office locations. These lines must be bisected to determine the direction of the division lines and the bisecting points will lie at the points *e* and *f*, the diagonal corners of the quadrilateral *f A e B*. At the points *e* and *f* draw the perpendicular *e x e x' f x''* and *f'''*, including the spaces *x e x'* and *x'' f x'''*. From inspection, all the stations within these areas can be taken indifferently, to either *A* or *B*, while the stations in the space *x'' f A e x'* must go to *A* and those in *x e B f x'''* to *B*.

Ordinarily speaking, compliance with *Conditions I.* and *II.* is sufficient to sub-divide any territory as may be desired, but it is conceivable to imagine such a distribution of stations as would permit the fulfillment of these requirements when the position of the division lines is indeterminate, or could exist under the specifications given in more than one location. Therefore, for strict accuracy, some criterion is needed whereby it is possible to discover if desired,

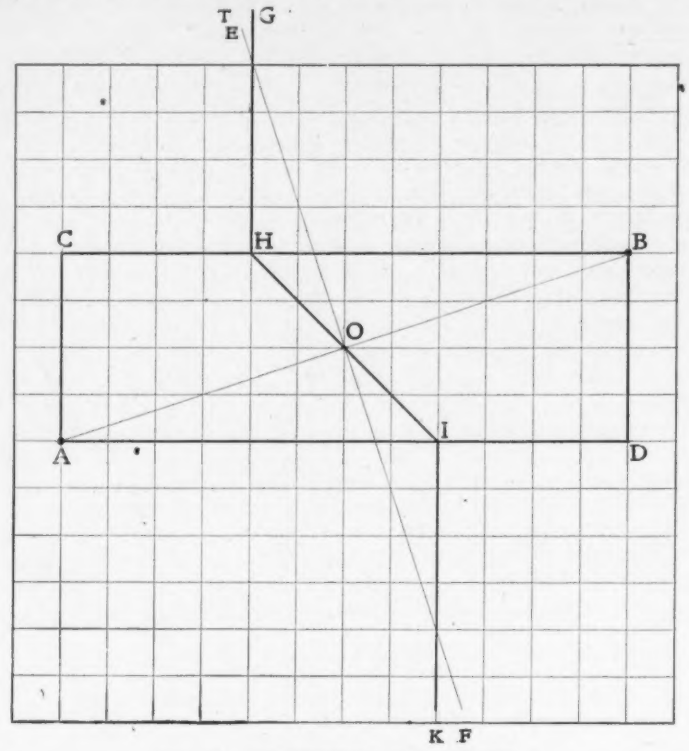


FIG. 24.—SUB-DIVISION OF TERRITORY.

which of several possible locations of telephonic centers and corresponding division lines that all fulfill the preceding conditions, will yield the desired minimum mileage.

In Fig. 26 let *A B C D* represent any territory with any station distribution, the lines of the paper representing the street directions. For simplicity assume the district to be divided into two parts of which the telephonic centers are P_1 and P_2, and let *E F* be the di-

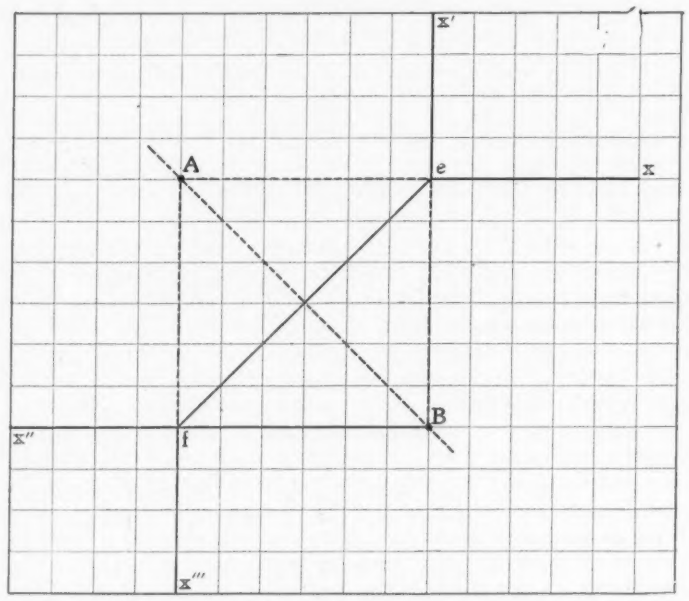


FIG. 25.—SUB-DIVISION OF TERRITORY.

vision line between them according to *Conditions I.* and *II.* Suppose some other location of this at, say *E' F'* would also carry out the conditions. As the line *E F* moves to its new location *E' F'*, it will cross a certain number of stations which may be denoted by *R;* so when it has arrived at *E' F' R* stations will have been transferred from the office at P_2 to that at P_1. But the law of telephonic center location requires an equal number of stations to be on each side of a

line drawn through the center parallel to the co-ordinate axes, and P_1 and P_2 were so located.

If, now, R stations have been taken away from P_2 and added to P_1, this equality is destroyed and P_2 and P_1 must be moved in the same direction as $E\ F$ till each has crossed $\frac{R}{2}$ stations. To accomplish this, suppose P_1 to move C units into P_1' and P_2 to move b units to P_2'. Let $G'\ H'$ and $M'\ N'$ be the respective new axes of Y through the new telephonic center at P_1' and P_2'. Let X_1 and X_2 be, respectively, the average abscissæ of $\frac{R}{2}$ stations from $G\ H$ and $M\ N$, and m the average abscissæ of R stations from the line $E\ F$. Let l_1 and l_2 be the distances of $E\ F$ from P_1 and P_2, respectively. Let S_1 and S_2 be the number of stations in office P_1, and office P_2 and L_1 and L_2 the

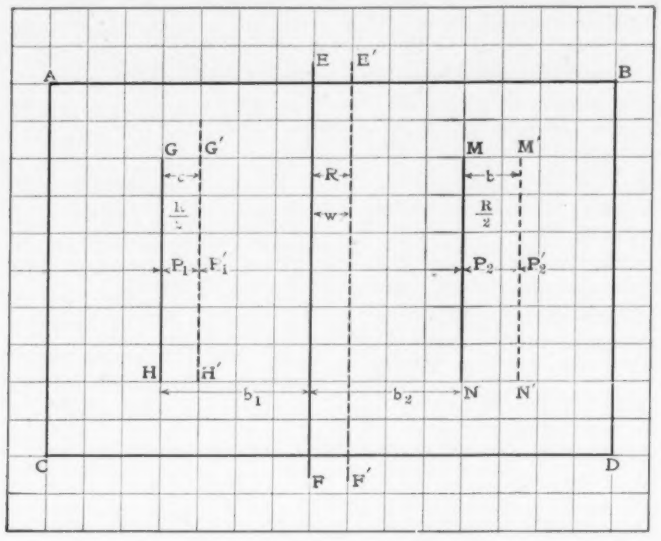


FIG. 26.—SUB-DIVISION OF TERRITORY.

average abscissæ in each division. Then $S_1\ L_1$ and $S_2\ L_2$ will, respectively, be the sum of all abscissæ in each division.

When $G\ H$ moves to $G'\ H'$ all stations on the left of $G\ H$ have their lines increased by an amount C. Those on the right of $G\ H$ have their lines decreased by C. While $\frac{R}{2}$ stations crossed by the moving line have their abscissæ changed by an amount $C - 2\ x_1$. Similarly it is easy to show the change in abscissæ in office P_2. As the line $E\ F$ moves to $E'\ F'\ R$ stations are changed from P_2 to P_1. Originally, these stations had abscissæ represented by $R\ (l_2 - m)$. When transferred to office P_1' their abscissæ will be $R\ (l + m - C)$. It is now easy to calculate the sum of the abscissæ in the two parts of the given territory both before and after the division line is shifted. The sum of the abscissæ *before* the line moves is $S_1\ L_1 + S_2\ L_2$. The sum afterwards is $S_1\ L_1 + S_2\ L_2 - R\ x_1 + 2\ R\ m - R\ x_2$. Subtracting the latter expression from the former there remains the quantity $2\ R\ m - [R\ x_1 + R\ x_2]$ This is the difference in mileage caused by the movement of $E\ F$ to $E'\ F'$.

Considering this expression, so long as $2\ R\ m$ is greater than $R\ x_1 + R\ x_2$, it has a real positive value indicating that there is an increase in mileage by the movement of $E\ F$, and that the original location of this line is the preferable one. When $2\ R\ m = R\ x_1 + R\ x_2$ the expression reduces to zero, showing that the new location has made no change in the value of the sub-station abscissæ, while if $2\ R\ m$ is less than $R\ x_1 + R\ x_2$, the expression has a negative value proving that in the new position the sub-station distances are decreased, and the arrangement of groups improved. $2\ R\ m$ represents twice the sum of the distances of the sub-stations crossed by the moving division line measured from its original position. $R\ x_1$ and $R\ x_2$ represent the sum of the distances of the sub-stations crossed by the axes of Y in each case as they move from P_1 to P_1', and from P_2 to P_2', also measured from the original location. The criterion is, therefore, deduced that when twice the distance from the original position of the division line to sub-stations crossed by it as it moves, is greater than the sum of the corresponding distances of the sub-stations crossed by the co-ordinates through the several offices as they move, a change in the location of the division line is detrimental.

If the most complete and exhaustive analysis be desired the expression $R\ [2\ m - (x_1 + x_2)]$ may be used to determine the effect of moving a division line over an entire territory, thus ascertaining the effect on sub-station lineage of every possible position of the line. If for successive points the value of this expression be plotted, a curve is obtained giving the relation between sub-station lineage and location of divisions between offices. It is conceivable that several minima could, under some circumstances, be found from which the best one could, by inspection of the curve, be discovered.

By applying the same process to the other co-ordinate axis, and combining the results of both analyses, the effect of every possible sub-division may be plotted. At first sight the process appears formidably laborious, and there is no gainsaying that to secure valuable results considerable time must be expended, yet with a good map, a square arranged to slide rectangularly over it, whose edges are graduated to read directly in wire mileage, and an adding machine, it is surprising how fast a skillful operator will sub-divide a district. Again, exchange sub-division is chiefly of value to large and telephonically very populous territories, where the saving of a very small wire mileage on each of the lines of many thousand stations may aggregate a very handsome return on a few weeks' labor in the drawing room.

Practically the process is much simpler than the theoretical description would indicate, for provided with a good map on which stations are plotted, and armed with a fair local knowledge of the various business interests of the territory the skillful telephonist will, by inspection of the map, pick out the approximate groups into which the whole territory should be divided in a general way. The telephonic center of the subordinate groups may then be quickly located and the boundary lines sketched in accordance with *Conditions I.* and *II.*, and the wire mileage to all stations calculated. For a large territory it is usually best, for reasons to be subsequently recited, to make several sub-division designs, and compare the several wire plant expenses with each other; therefore, for any city of, say, 500,000 inhabitants, it is well to make four or five trial sub-divisions splitting the territory into, for example, four, six, eight and ten groups, and plotting a resulting curve of the relation of sub-station mileage.

Every time that a subordinate group in any given territory is sub-

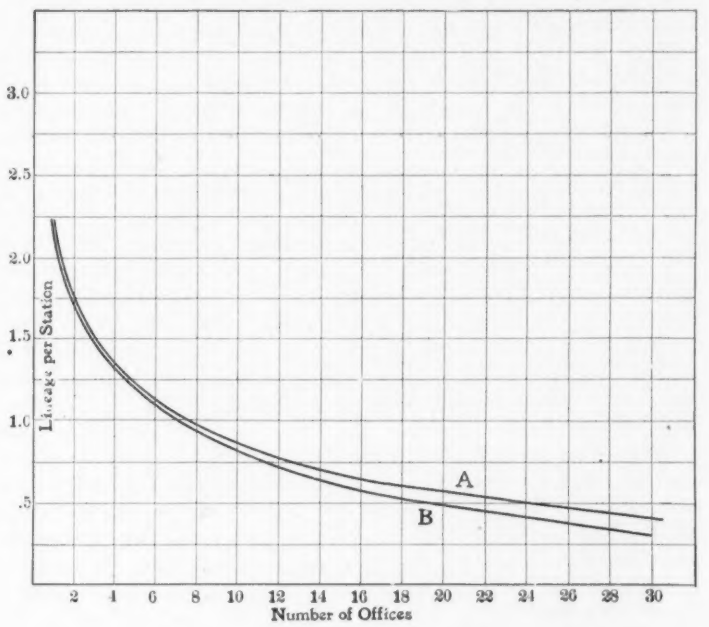


FIG. 27.—CURVES OF SUB-STATION MILEAGE AND NUMBER OF OFFICES.

divided the process of division slightly reacts on all other groups, so for strict accuracy, it is necessary after any group is split, to correct the boundary lines and telephonic centers of all others. but practically this error is too small to be entertained. To illustrate the process of finding the curve of sub-station mileage and number of offices, together with the effect of probable error when the mutual adjustment of boundary lines and telephonic centers referred to is neglected turn to Fig. 27.

The curve B gives the relation between the number of offices and average length of sub-station lines in a hypothetical territory resembling an average city of 500,000 inhabitants. The number of offices varies from one with an average sub-station mileage of 2.25 to 30

with an average mileage of .30. In this case all the corrections have been made. Curve *A* is plotted without adjusting adjacent boundary line and telephonic centers when a sub-division is made. The failure to make this adjustment returns results that are somewhat too high. For four offices the unadjusted curve is one-twentieth of a mile, or about 3.75 per cent in error. But for 30 offices the error is about 27 per cent, but it is not possible to give a general error curve applicable to all territories, it is best to use the uncorrected mileages for the various trial sub-divisions, and when the actual number of offices is finally selected to carefully adjust all boundary lines and telephonic centers to each other.

The First Convention of the Interstate Independent Telephone Association.

INDEPENDENT telephone men from the states of Illinois, Indiana, Iowa, Wisconsin, Michigan, Kentucky and Missouri met at the Sherman House, Chicago, April 9, 10 and 11, 1902, for the purpose of organizing the Interstate Independent Telephone Association. At a preliminary meeting, held in Chicago in January, 1902, by a few independent telephone men from the states named above, a committee was appointed to take charge of getting together a convention of telephone men from the seven states surrounding Illinois. This committee consisted of Messrs. H. B. McMeal, J. J. Nate, I. A. Lumpkin, S. A. Dinsmore and W. E. Burke. This committee had practically the entire responsibility for the convention arrangements.

The first half day of the convention, Wednesday, April 9th, was devoted to registration and the issuing of credentials. In the afternoon, Dr. I. A. Lumpkin, of Mattoon, Illinois, who has always taken a prominent part in independent telephony in Illinois, called the meeting to order, and made a brief address, relating some of the things which led up to the calling of the present convention for the purpose of forming a permanent organization. In conclusion, he said: "What is the object of this meeting here in Chicago to-day is a question I have often been asked. It is simply a meeting in the mutual interest of the states here represented, and to bring them into closer alliance one with the other, to the end that these meetings may be the cause of forming some plan whereby long-distance toll lines may soon be built from Chicago to the several states represented here to-day, for it is a fact that these public gatherings attract the attention of the public, and, like the press of our country, have much to do with the forming of public sentiment, and in this way it is possible to reach the ear of the mayor and city council of this city and obtain a franchise, after which the money would soon be raised to build an exchange in this city."

The convention then adjourned until Thursday morning.

The Illinois Independent Telephone Association met Wednesday afternoon following the Interstate meeting, and elected the following officers: President, Milford Savage, Champaign; vice-president, E. M. Harwood, Shelbyville; secretary, L. C. Schwerdtfeger, Lincoln; treasurer, G. M. Hughs, Hume. A committe was appointed to draft amendments to the constitution. This committee consisted of E. D. Glandon, Pittsfield; B. F. Wasson, Clinton; P. M. Warner, Rossville. The time and place of the next meeting was left for the president and secretary to decide.

Wednesday evening the telephone exchange owners and operators, and as many manufacturers as could be accommodated by the 500 seats at the Sherman House banquet room, sat down to a banquet, tendered by the telephone manufacturers and supply houses and the electrical press. Besides the main banquet for the men, the ladies—wives and relatives of the telephone men attending—had a banquet in an adjoining room. Mr. J. J. Nate acted as toastmaster, and Mrs. Geo. A. Briggs as toastmistress.

Thursday morning Dr. Lumpkin again called the Interstate Convention to order, and resolutions were passed that each state name two members of a committee to select a president, secretary and treasurer. This committee reported at the afternoon session.

The "Future of the Business Part of Telephony" was taken up by C. F. Bennett, of Waterloo, Iowa. After touching on the methods of financing a modern telephone plant, Mr. Bennett said, in part: "The trend of methods of charging is not clearly seen yet. In one locality flat rates prevail, and in some foreign countries this seems to have stood years of competitive influence. In other localities the tendency is to measured service, which likewise, in Europe, has its supporting argument. I can see equity in neither. A minimum flat rate is necessary in order to warrant an extension of the service on the measured rate plan. By this, I would suggest a charge of a low flat rate for private telephones for a corresponding low measured per message-rate, and a percentage of the latter to go to the one who pays the former and co-operates to increase the latter. I fear this is the outcome, and I say 'fear,' for it will be a costly one which should be long anticipated. Telephone business in the future will have many subdivisions. I am wondering what features will be their outlines. Will they be municipal or commercial? Governmental influences may in the future reach as far as ownership. Certain it is, they will effect some of the following changes: Remuneration for use of public ways, supervision of franchise rights, investigation of standard methods of construction to require quality of service, restriction of tariffs and supervision of competition. These will harm little and help much to those who see farthest into the coming work. From the fact that the general questions rising between connecting companies will come prominently before this association, I omit the extended discussion and will only say that we should be guided by the experience of the railway companies, and quickly find that we must deal with each other, remembering that the most dangerous method of doing good is to give more than value received. Regular balances between companies are the greatest bond of friendship I have known."

"The Telephone Situation in Wisconsin" was reviewed by Richard Valentine of Janesville, Wisconsin, of which the following is an abstract: "From conversations I have had with telephone men from other western states, I conclude that the telephone situation is the same in Wisconsin as elsewhere; that is, the business is growing beyond all expectations. We have in our state 176 independent telephone companies. Statistical reports received from a majority of them and a fair estimate of the balance shows:

Copper metallic toll lines	200 miles.
Iron metallic toll lines	3,000 "
Iron-grounded toll lines	4,000 "
Toll stations	650 "
Telephones in use	23,000 "
Invested capital	$2,316,875

"Of this $366,975 is represented by 16 companies that have been incorporated since Jan. 1, 1902.

"Much of the growth has been within the last three years. One of the most encouraging signs of the times is the rapid growth of the farmers' lines. They are going up in all parts of the state, and the construction is mostly complete metallic circuit. We find the farmers to be our most enthusiastic customers, and it is a business we will do well to cultivate. What independent telephony in Wisconsin needs most is an exchange in the cities of Milwaukee and Chicago and a system of copper toll lines to connect up our system. The status of the independent franchise ordinance in Milwaukee was briefly discussed. Efforts of Bell interests to make working agreements with independent companies throughout the state were described, and the making of such agreements condemned." In concluding, he said: "In my opinion, the weak point in the independent telephone movement is in the great multiplicity of small companies, and I believe the time is not far distant when a movement for the consolidation of the small companies in each state will be adopted. Consolidation would bring us economy in management, economy in the purchase of supplies and economy in construction. Under the present condition many small companies can be said to have no management whatever beyond an operator and the lineman. They are, therefore, the prey of cheap instruments, the dealer in common fence wire, and the vendor of bean poles, who tells them 15 poles to the line is sufficient for any telephone line. With only one company in each state, we would have first-class instruments and the best of construction. We would have first-class copper toll lines and all the good things we long for. How this consolidation is to be brought about, I will leave that to your consideration, but that it is to come in time I have not the least doubt."

"The Future of the Independent Telephone Movement from the Operators' Standpoint" was the subject of a paper by H. C. Rainey, of Fairfield, Iowa, of which the following is an abstract: "The development in the independent telephone business has been one of the most remarkable movements in the business world in the last decade. Twenty years ago the independent telephone in a commercial way was wholly unknown, and it is only within the last ten years that the movement began to assume any importance. The business had its foundation in the necessities of the people. I wish to call your

attention to the telephone proposition from the standpoint of men who have invested in independent exchanges and toll lines with reference to future probabilities and possibilities. Whether we consider the amount of capital invested or the service rendered, the growth of the independent exchange and toll business is most wonderful. Almost every village and every neighborhood enjoys the blessings of the telephone. At the present rate, but a few years will elapse before the telephone becomes as much a part of the home as a table or a stove. The remarkable and growing demand for the telephone is at once the guarantee for a prosperous future for the business, and at the same time the most dangerous element in the business. It is a sure guarantee because it is the proof of a demand that must be supplied. Its danger lies in the fact that people are almost wholly ignorant of the laws that govern the business. They are ignorant because the business is only in its beginning and the laws governing it are not yet developed, and because the business itself is not governed by the rules that govern any ordinary business. This has led to a most serious difficulty. A great mass of the people have become possessed of the idea that telephone service can be obtained for almost nothing, and for that reason they are disposed to make demands for a low-priced service that cannot be complied with. The great reduction in price made by the independent companies from the old Bell rates may have something to do with the people getting such ideas, but I think the most potent factors in bringing about this condition of affairs have been the manufacturers of cheap telephones who have sought the farmers' trade, and led him to believe that any kind of a telephone and a fence wire would make a first-class telephone system, and a farmer finding that by this system he can carry on a conversation with his neighbor a quarter of a mile away has accepted the idea and is acting accordingly.

"This condition constitutes one of the greatest dangers that the operator has to face. He has invested his capital in his exchange and small toll-line system, and because he will not give some set of farmers the free and unlimited use of the same, they proceed to build parallel lines and ask for a franchise and start a competing exchange. I think that time and experience on the part of the farmer will evidently remove this trouble, but in the meantime it may have financially wrecked the small operator. If the independent companies engaged in the business will take a stand together and refuse connection to all companies except on strictly business principles, the evil will be greatly minimized. It, of course, follows that the larger and stronger the independent companies engaged in the legitimate business become, the better they will be in control of the situation. This brings us to what, in my judgment, is one of the urgent things of the future in our business; that is, a consolidation and a larger community of interests in our companies. I believe this must come along the lines of clearing house association and long-distance telephone companies made up of small independent companies.

"The long-distance toll line is one of the recognized things of the future. I do not mean the lines hundred of miles long, but lines covering a distance of 25 to 150 miles. It is a recognized fact that at least four-fifths of the so-called 'long-distance' business is done within a distance of 100 miles. One of the best means of solving the long-distance question is improved construction and equipment. Business men, especially, will soon learn that they cannot get good service except for fair compensation, and will also learn that poor service is dear at any price, and in view of these facts the future of the independent telephone business is largely what the independent telephone men see fit to make it. Their fate is in their own hands. We no longer have anything to fear from the old companies as to infringement of patents. One of the dangers that will require our attention is the matter of hostile legislation. If there is anything we should avoid it is asking for too much legislation supposed to be in our favor. What we need is to carefully guard what we have, rather than to ask for more. Telephone securities and income are less affected by hard times than any other form of public service company securities. The outlook for the coming year is brighter than at any time in the history of the telephone business. Reports from every section indicate an enormous growth. In the prosperity we enjoy as a country the telephone business will receive its full share."

"The Telephone Situation in Indiana" was the subject of an address by L. Frazee, of Connorsville. He said that to-day the paramount issue in the independent telephone situation differs widely from that of the past. The past was a fearful struggle against the great and powerful enemy. Some of the adversities of the earlier days of independent telephony were related in an interesting and amusing way, and the beginnings compared with the magnificent developments of to-day. The Indiana field, which the Central Union Telephone Company has been developing for more than twenty years, now supports, Mr. Frazee said, 19,000 Bell telephones, according to Central Union claims. In the same state he gave the number of independent telephones as 65,000. There are some 25 counties in the state with no Bell exchanges. There are not more than six county seats which the Bell telephone has exclusively. In most of the cities where there are two companies, the independents have three or more telephones to one of the Bell. In Mr. Frazee's own county and the immediate surrounding counties there are in operation approximately the following number of telephones:

	Central Union. (Bell.)	Independent.
Fayette County	160	660
Franklin County	...	195
Union County	...	128
Wayne County	325	2,050
Henry County	325	900
Rush County	125	500
Total for 6 counties	935	4,433

"While we are disposed to congratulate ourselves over these results," he said, "should we stop here? Are the Independents in any county of those mentioned keeping abreast with the demands? They certainly are not. The more telephones that are installed the greater the demands for the others. When will this stop? Who can tell? It seems it will continue until every person who can afford it will have a telephone. This brings us to the present paramount issue. How are we to conduct this business at a fair profit? We all know that the more on an exchange beyond 100 or 200 telephones, the more it costs to install a telephone and operate it. Small is the exchange with the minimum cost of installation and operation. Now, where is the exchange that has been built that will not grow to four or five times as large as is contemplated? The lines must average longer. Those originally built in turn must be made metallic. There must be more cable. In many instances overhead work must be changed to underground, the old switchboard discarded and the one costing more per drop installed; the larger exchanges must be changed to central energy. Labor and most materials are at least 25 per cent. higher than they were four years ago, which still further complicates matters. Here comes our good brother farmer of Indiana (and no doubt of other states) some distance from the city exchange; building his own lines like mushrooms springing into existence between two days; using home timber, any kind but the right kind; using wire, and it is of the quality called fence wire; installing his telephone complete for $25.00, not counting his work (and it is right that he should not count that) (laughter), and operating his system on 25 cents per month per telephone. Now he comes in the form of a committee with powers plenipotentiary, and meekly informs you that it will be to your interest to give him free connection with your exchange, or at least some proposition that is not feasible in view of operating an enlarged exchange.

"The most of us must face this proposition, and we who feel that we have successfully met the Central Union Telephone Company, have problems yet to solve. If you give it the same study and give it the same zeal, there is no doubt of a successful outcome. My personal view is that the city exchange should own all the lines for at least five miles from the exchange. If service is needed farther than that, and farmers or villagers, or both, build an exchange then run a circuit, or more than one circuit if necessary, and charge each of the subscribers 50 cents a month for your entire exchange. As a general proposition, I believe a farmer should have the privilege of talking to his county seat without paying toll. The telephone is a great blessing to the farmer, and its use to him should not be restricted by charging him toll for reaching his court house, his lawyer, his physician or his market. This line of the business, as well as other lines, should be conducted on a carefully studied basis, which will pay a fair profit, giving the farmer the unlimited use of the service. Our own plan of building farmers' lines is as follows: We furnish all material and do the work except that the farmers haul the poles, dig the holes and assist us in setting the poles. We use 20 and 25-foot poles, 32 to the mile. We build a metallic circuit of number 12 steel wire, and use long cross-arms, spreading the wires Western-Union style. The wires widely separated reduce crosses,

thereby having your 'phone get out of order less often and reducing maintenance. We put from five to eight 1,600-ohm 'phones on a line. We have one selective signal line, it having been in operation about eight months so far. However, we do not consider it a success, as we have more trouble with it than regular bridged 'phones, and find it much harder to locate trouble on this line. Our rates to farmers are $15.00 per year in advance, or $4.50 per quarter in advance, or $1.66 per month for any rental in arrears. We feel that we can maintain good service at these rates, and doubt if good metallic service can be furnished for a number of years, at a profit, at any less rate. After all we should keep in close touch with our patrons, and give careful attention to their wants. The crime of the Bell Company has been utter disregard of this. This caused the birth of independent telephony, and we should not be unmindful of this fact." Mr. Frazee expressed himself as against measured rates for conditions as found in Indiana.

The Thursday afternoon session was opened by the report of the committee to select officers, which resulted in the election of H. C. Rainey, of Fairfield, Iowa, as president; Dr. I. A. Lumpkin, of Mattoon, Ill., vice president; E. M. Coleman, Louisville, Ky., secretary, and W. H. Harper, of Madison, Wis., treasurer.

"Public Confidence in the Independent Movement," was next discussed by E. R. Conklin, of Aurora, Illinois. He outlined some of the necessary elements which should characterize independent operations. "We are not in the position of a mariner without a compass, but on the contrary, have a more or less thoroughly tested chart with the true, steady, unerring index of public sentiment to keep us in our course. The chart referred to is the history of the Bell Company. By reference to it we are able to avoid the hidden rocks which have proved so disastrous to its popularity. The answer to the question, 'Who needs telephones?' is, every business man, whether professional, merchant or farmer. The wants of none of these can be disregarded. One of the pioneers in the independent telephone field once made a standing offer that he would pay $100 per telephone for every telephone in one of our most thickly populated states that could have been proved to have been in a farmer's residence on his farm before 1894, or before independent telephone companies began giving service. He said the bold proposition had never cost him a cent, because no farmer had a telephone prior to that date. Now, thanks to the independent movement, this condition has changed, until at present thousands of farmers in every State have them in their homes, and, who needs a telephone more than the farmer who is so far off from the telegraph and telephone stations, post office and family doctor, say nothing of his social isolation? Who of all classes has any greater need of the telephone? As to the method of supplying customers, the former Bell custom was to establish just as few exchanges as possible, and to charge the subscribers so high a rate that only a small percentage of the people could afford a telephone. Let us not venture by these rocks, but rather let us establish ourselves on a more liberal basis and give every subscriber the highest telephone service known to the arc. It is true that where lines are extended in the rural districts for several miles, it becomes necessary, in order that the service may become popular and of real use to the community, that party lines should be resorted to in order to bring the service within reach of the average farmer. Somewhere between the extortionate price charged by the Bell Company and a price so cheap as to be unremunerative is a point where the volume of business at a fair profit will net the largest profit upon the investment, and this is the point to be sought. Right along this line I wish to say the mistake is just as liable to be made of naming a price that is too cheap as of making it too high. A business man is willing to pay a living, profitable price for our stock in trade—telephone service." Mr. Conklin then briefly touches upon the enormous present growth in the telephone business and the importance of more and better toll connections for all companies.

At Friday morning's session, W. H. Crumb, of Chicago, read a paper on "Telephone Construction," which took up, in detail, matters of outside construction. The constitution of the association was read and adopted, the states finally included in the association being Illinois. Iowa, Indiana, Michigan, Ohio, Kentucky, Missouri, Minnesota and Wisconsin.

In the afternoon of Friday, Mrs. Anney McElroy Brett, of El Paso, Tex., president and general manager of the Southern Independent Telephone Company and the Brett Telephone Construction Company, made a short address, advocating an education of the public as regards cost of telephone service with increase of number of subscribers.

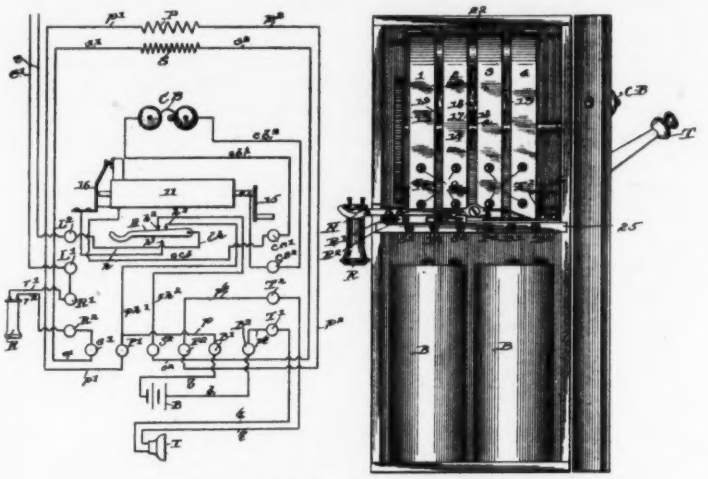
Dr. H. S. Herr, of Ottumwa, Iowa, read a paper on the "Cost of Construction and Maintenance of Telephone Plants," in which his estimate of depreciation as ten per cent. per year was criticized in the discussion which followed, as too high. Later a resolution was passed, that it was the sense of the association that the depreciation on a well-constructed and well-engineered telephone plant should not exceed five per cent. per year.

There were present about 250 independent telephone exchange owners and operators from outside of Chicago.

New Telephone Patents.

The issue of April 1st contained no patents relating to telephony. In the case of some telephone patents one has read, the appropriateness of omission on such a date would be in doubt. Telephone patents have been neither very numerous nor strikingly novel during the past few weeks, the issue of April 8th contains two only, and when people come to take out patents on telephone sets it would almost look as if the well of telephonic invention were suffering from a temporary drought.

Mr. James G. Nolen, of Chicago, patents a combination telephone instrument, in which "a call-bell generator, a bell-ringer, an induction-coil or transformer, and the switch-hook are all combined and constructed in one integral self-contained unit," which is hardly such an unusual arrangement of a telephone set as to warrant an application to the Patent Office for protection. "The object of the invention is *to improve the quality of each of the different instruments* combined in the single unit by virtue of this construction, and to so combine the associated instruments composing a telephone set in one construction



FIGS. 1 AND 2.—NOLEN'S COMBINATION TELEPHONE.

as to avoid the necessity of making complicated electrical connections at the time when the instrument is placed in service, all of the connecting binding-posts being placed in accessible positions upon the insulated base upon which the instrument is mounted." The italics are ours. To improve the quality of each of the different instruments by virtue of combining them in a certain mechanical manner sounds a little like modern magic. Fig. 2 gives a general idea of Mr. Nolen's improved telephone set. The binding-posts are mounted on the insulating base 25, each of the instruments in the set, even down to the switch-hook, being wired to its set of binding-posts, as shown in the diagram of connections, Fig. 1.

An addition to the army of three-wire party-line systems is contained in the patent granted to Mr. William E. Pembleton, of Wittenberg, Wisconsin. This system does not provide for selective signalling nor automatic switching nor any of the usual objects aimed at by three-wire party-line system, its object being to "eliminate resistance of the coils of the call-signal magnetos from the talking-circuit of an electric telephone system," to provide means for testing the line at any station to discover whether it is busy or not, and means for automatically signalling on the line the cutting in or out of any station. Mr. Pembleton has worked out a fairly complicated arrangement of apparatus and circuits for accomplishing these objects. referring to Fig. 3, lines *A* and *B* are the talking circuit, and *B* and *C* the signalling circuit, though the generators and ringing-keys

are so wired that calls can be sent over lines *BC* or *BA*. At the subscribers' stations, lines *BC* are short-circuited and *j' j'* when the hook is up, cutting out the signalling apparatus. The hook is prevented from rising when the receiver is taken off by the pivotted latch *M*, to be swung aside by hand when desired; the receiver is then in bridge across lines *AB*, the bridge containing also battery *M* and ratchet contact breaker *N*. On turning the ratchet a series of clicks will occur in the receiver if the line is closed at another station, but there will be no sound if the line is open, and therefore free. The hook *H* carries a bent arm *H'*, having two wedges or shoulders *q q'*, the lower of which, *q'*, has insulation on the lower surface; when the hook is allowed to move up *q* and *q'* make contact

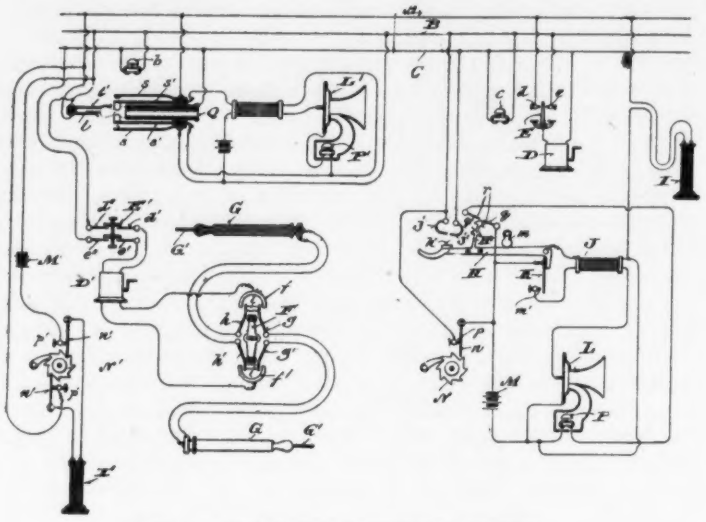


FIG. 3.—PEMBLETON TELEPHONE SYSTEM.

with spring *r*, thus closing twice in succession the circuit containing attery *M* and audible signal *P* attached to the transmitter, giving a double signal on the line indicating a station cutting in. When the hook moves down only *q* makes contact with *r*, the lower surface of *q'* being insulated, and a single signal is given, indicating a station cutting out. So that a station cannot cut in or out without giving a distinct signal of each operation, audible to those using the line.

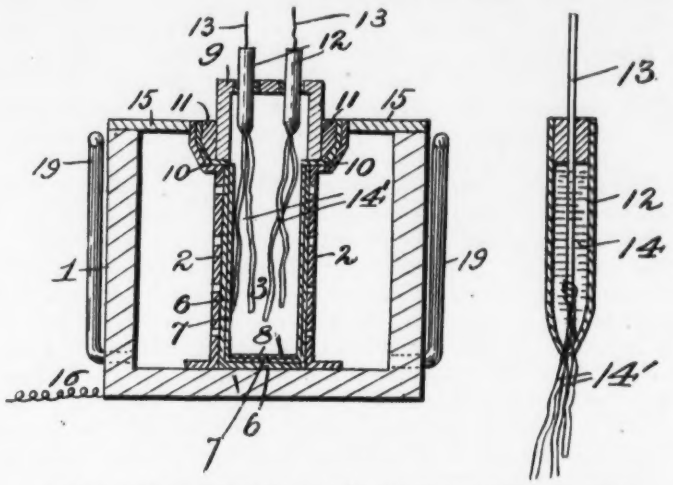
The arrangements at the central office shown on the left of the diagram give similar results. The generator *D* is wired to key *E'* for ringing on line *BC*, and to key *F*, by which either plug may ring on line *AB*. As the call-bells and signals *cb* are shown wired to *BC*, it is not clear why signalling current is wanted on circuit *AB*. The vibrating contact busy-test circuit is the same as at the sub-station. The automatic signal of cutting in is given by means of closing springs *s's'* on springs *SS* when the plug is inserted in the jack *Q*. The plug makes a similar contact on being withdrawn. Besides its normal tip, which is solid with the sleeve, the plug has an abnormal tip or pin which makes contact with the rear spring *t* of the jack. and so connects to the line *A*. On the whole, while considerable ingenuity is shown in the arrangement of circuits and apparatus, this system can hardly be considered the last word in party-line methods.

Electrolysis of Brine.

An electrolyte cell recently patented to Frank McDonald, of Rumford Falls, Maine, and designed for the production of chlorine and caustic soda from brine, belongs to the type rendered familiar by the early constructions of Le Sueur, and the later forms of Hargreaves and Moore, in which a perforated cathode is employed as a support for the diaphragms which enclose the anode compartment. In the later forms above mentioned, the cathode compartment has been empty, and the alkaline solution has been permitted to gravitate freely from the cathodes; in the Le Sueur cell the cathode compartment remains filled with the caustic solution, and the hypochlorites which result from the diffusion of this caustic into the anode cell, are decomposed by the graduated addition of hydrochloric acid. The device now patented operates upon the Le Sueur principle, and is therefore to be considered as a modified form of this cell. The anode is formed of a number of platinum wires or ribbons, fused into a glass tube and contacting therein with mercury, through which the electrical connection is made. Aside from the radial arrangement of the platinum ribbons to adapt them for use with a horizontal cathode, this is precisely the form heretofore described by Le Sueur and patented to Carmichael.

The cell is illustrated herewith, in cross sections through the three compartments, in Fig. 1, Fig. 2 showing the anode in detail. The iron tank 1, is divided by perforated iron cathode plates 2, suitably flanged, into three compartments, of which the central, indicated by 3, contains anodes 14'. The diaphragms comprising layers of asbestos cloth 6, faced with asbestos paper 7, are supported by the cathode. The cover 9 of the anode cell is sealed by cement 11, into the upper flanged portion of the cathode plates, and the anodes are supported by this cover. A bed of cement 8, covers the bottom and end walls of the anode compartments and protects the iron from the action of the electrolyte.

The lateral or cathode compartments are likewise tightly covered, as at 15, and are provided with suitable induction pipes for water and with eduction pipes 19, arranged to draw the caustic from the bottom of the cell. The anodes comprise a glass tube 12, into the



FIGS. 1 AND 2.—SECTIONS OF CELL FOR ELECTROLYSIS OF BRINE.

lower end of which platinum ribbons 14' are sealed; the anode conductor 13, contacts within the tube, as do the ribbons, with mercury 14. These ribbons constitute the working anodes and hang freely in the vicinity of the diaphragms.

The chief departure in this cell from the Le Sueur type is the substitution of vertical perforated plate cathodes for the inclined bed of wire sponge originally used; the changes involve both the structure and position of the cathode, and both are distinct advances in that they facilitate the free escape of the liberated hydrogen.

The Kelvin Reception.

Matters have advanced very favorably for the reception to Lord and Lady Kelvin by the American Institute of Electrical Engineers and other technical societies, at Columbia University, on April 21. The committee, of which Prof. Crocker is chairman, has been working very hard and successfully, and the present indications are that between 2,000 and 3,000 people will attend, including chiefly members of the societies and a large number of distingushed guests, as well as many leading educators present also for the inauguration exercises of President Butler. The reception will be held in the big gymnasium, and will last from 8.30 to 11 P. M. Owing to the size of the affair and other difficult conditions, it has been deemed wisest by the committee and university authorities not to provide any collation, but aside from the special preparations the university, which takes a great interest in the affair, will leave intact also the special decorations used this week at the Butler exercises. Addresses will be delivered by President Butler, Dr. Woodward, Prof. Elihu Thomson, Prof. Webster and others, and Lord Kelvin will make a reply. The proceedings will be interspersed with music. In addition to the regular admission tickets, the committee has had prepared a very handsome large invitation card, which will serve as a souvenir of the occasion, printed in gold and two tints of blue and embracing a beautiful little portrait of Lord Kelvin as well as his coat of arms, and vignettes of Columbia and Glasgow universities; as well as little panels with the initials or badges of the contributory bodies.

American Underground Electric Traction in England.

A situation that had become somewhat confused and complicated at this distance appears to be cleared up by the following cable dispatch from London, of April 10: The *Times* understands that an agreement has been reached between Charles T. Yerkes, Speyer Brothers, Speyer & Co., and the Old Colony Trust Company (of Boston) and a new company, with a registered capital of £5,000,000, for the purpose of installing electricity on the District Railway and four other lines. The four lines in question are the Brompton and Piccadilly Railway, the Great Northern and Strand Railway, the Charing Cross, Euston and Hampstead Railway, and the Baker Street and Waterloo Railway. Parliamentary powers have already been obtained for these lines. It may take five years to build the whole system comprised in the scheme.

With regard to this, Mr. Yerkes adds: "It was soon discovered that the original company, with a capital of a million, was too small. I went to America with the intention of forming another concern, which would absorb the original organization, and have an additional four million of capital. In the meantime, four railways were purchased, the Baker Street and Waterloo, Brompton and Piccadilly, Great Northern and Strand, and the Charing Cross, Euston and Hempstead. Thus, a system of intramural transportation, enabling persons to travel in most of the districts of London, was assured. The expenditure of the present capital of the new concern will extend over a period of three years. I intend to form a comprehensive system of intramural transportation for London, on the basis of cheap fares and rapid transit."

The Associated Press learns that the new Underground Electric Railways Company, as it is called, will eventually increase its capital to £15,000,000. Mr. Yerkes will be chairman; but the Speyers and the Old Colony Trust Company will have a controlling interest. They will nominate the directors, who will all be English, except Mr. Yerkes and Mr. Adams of the Old Colony Trust Company. The capital will be privately subscribed in London and New York. In addition to the district line, four partially completed and projected tubes come under the control of the new organization. Mr. Yerkes's methods will be adhered to, and he will carry out his previous policy.

The new company is incorporated as the Underground Electric Railway Company of London, Limited. Its main property will be the Metropolitan District Railway, now operated by steam locomotives in connection with the Metropolitan Railway, the so-called inner-circle underground railway. Plans for the electric operation of both these lines have been agreed upon, the British Westinghouse Electric Company having the electrical equipment in charge. The Metropolitan District Railway is not held outright, Mr. Yerkes and his associates having large stock ownership, and the contract for converting the road to an electric line. Other roads owned by the new syndicate founded by the Speyers are the Baker Street and Waterloo Railway Company, the Brompton and Piccadilly Circus Railway Company, the Great Northern and Strand Railway Company, and the Charing Cross, Euston and Hampstead Railway. The development of all these lines will be carried out in accordance with the most modern American methods, and American cars and other equipment and machinery will be used.

Electrical Works in Germany.

In a communication upon the outlook for export trade in Germany, Mr. Frank H. Mason, the excellent U. S. Consul-General at Berlin, remarks incidentally:

"In order to make clear the present condition of the German market for these products, a brief review of what Mr. Vanderlip calls 'the Americanization of certain German industries,' which has taken place since 1870, may be of pertinent interest.

"It was about that time, or soon after the organization of the Empire, that Mr. Ludwig Loewe, a young and enterprising hardware merchant of Berlin, became impressed with the fact that American sewing-machines were finding a large and constantly increasing sale in this country. He compared them with the home-made sewing machines, recognized their superior construction and finish, and determined to see how this was accomplished. He went to America, visited sewing-machine factories and other machine shops, saw the work of automatic machine tools, doing with speed and unerring accuracy the shaping and fitting that had always been done by hand. He bought a complete outfit of American machines and tools, returned to Berlin and established a factory, which proved the germ and inspiration of a new era in German manufacture.

"That original factory has expanded until it includes, under management of the same daring and intelligent innovator, the Union Electrical Works, the vast private arsenal where the Mauser rifle is made by hundreds of thousands for the armies of many countries, and an immense machine shop and foundry of the most modern type, where hundreds of American machine tools—with an Allis engine driving one of the dynamos that generate electrical power for this vast equipment—have been employed during the past four years turning out lathes, milling machines, automatic screw cutters, planers, and stamping, punching, boring and reaming machinery, all modeled exactly after the best American types, and in some cases embodying improvements upon the originals. When, in the summer of 1900, the American mechanical engineers were brought here from Paris by Mr. Loewe in a special train and entertained for three days with princely hospitality, they said with entire frankness that nowhere in the United States had they seen a machine shop of more perfect plan and construction or containing so extensive and complete an outfit of the latest and most improved American machine tools. They found also everywhere about the place, as well as at the electrical works, American and German-American foremen and skilled machinists, who had taught here the methods which they had learned at Providence, Paterson, Philadelphia and Pittsburg. They saw the streets of Germany's capital traversed by electric street cars, built by the 'Union' and the General Electric Company, of Berlin, identical in every detail with those turned out by the great shops in the United States. Throughout all these establishments, which have in effect revolutionized certain industries in Germany, the American system of standard types with interchangeable parts, and to some extent the American method of treating workmen, have been introduced and permanently established. The Bergmann Electrical Works, of Berlin, is an example of a class of large industrial establishments founded in Germany during the past five years, in which not only the machinery and tools are of American make, but the technical directors, many of the foremen, and even some of the workmen are either native or naturalized American citizens who learned their handicraft in the United States. At the Bergmann works, the operatives are classified and paid by the American factory system, and have even given up the 11 and 4 o'clock stops for beer and lunch, which are customary in German workshops."

Wireless Telegraph Claimants.

Every day some new claimant for the honor of having originated wireless telegraphy springs up.—Daily paper.

Who invented wireless telegraphy?
"I," growled Professor Lodge;
"It is my own dodge.
I invented wireless telegraphy."

Who sent the first message?
"I," answered Shearer;
"With my coherer,
I sent the first message."

Who invented the receiver?
"I," whimpered Slaby,
Like a big baby;
"I invented the receiver."

Who spanned the ocean?
"I," said Marconi;
"I'll bet my money
I spanned the ocean."

Who talked with Mars?
"I," Tesla said;
"With my own head
I talked with Mars."

—The Rochester *Post-Express.*

A Pennsylvania Railroad Trolley Experiment.

The Pennsylvania Railroad has just abandoned an experiment which should never have been begun. It had failed to make its Burlington and Mt. Holly line, in New Jersey, succeed with steam, and therefore just changed the motive power to electricity. In practically all other respects the line remained a steam road and part of a steam system. These conditions are brought out very clearly in the accompanying dispatch from Trenton, N. J., of April 12:

The Pennsylvania Railroad has decided that its experiment in operating its small branch lines by electricity is a failure, and has ordered the demolition of the power-house of the Burlington and Mount Holly line, which was recently partly burned. The Pennsylvania owns a number of roads which it thought could be operated more successfully by using electricity instead of steam power. The company selected the Camden and Burlington County Railroad, which runs from Burlington to Mount Holly, a distance of seven miles. It cost $74,506 to equip the road for trolley purposes. The cars used were regular railroad passenger coaches with a double trolley bar. They were capable of a speed of over sixty miles an hour, but owing to numerous stops that speed was impossible. The advantage secured was a complete connection from Mount Holly and vicinity with all Trenton and New York trains, and those touching the Delaware front towns. These frequent trains did not increase traffic, but only gave the public a large variety of service. The first year the total cost of operating the road was $14,120. There has been an annual deficit ever since. The report of the company just filed with the State Board of Assessors shows that the operating expenses last year were $22,779.64, while the income from passengers during the year was only $12,658, and from other sources, $1,062, making the total earnings $13,720. The deficit, as recorded in the statement, does not represent the total loss, for the company made many experiments to improve the service and to cheapen it. For over a year the company has been considering the question of abandoning electricity because it could not serve the purpose of a railroad. The burning out of the power-house at Mount Holly brought the matter to an issue, and during the past week the order was given to tear it down, and the company does not hesitate to announce that the experiment is a failure, and that it willingly goes back to the steam locomotive.

Patents in Germany.

Referring to the doubt expressed by Signor Marconi as to the fair play he is likely to receive in the German courts when the issue between his system and that of Prof. Slaby is presented for adjudication, the New York *Times* says the apprehension is not without basis in the experience of most inventors who have attempted to sustain their patents in Germany against the piracies and obvious imitations of German citizens claiming rights as ex-post facto inventors. The average experience of the outlander, it says, is that it is extremely difficult to obtain in Germany a patent of any value, since if the subject matter is sufficiently important the hypertechnical objections raised by the Patent Office officials are usually found insuperable. If a patent is obtained, it is extremely difficult to sustain it in a suit for infringement against a German subject, and it is quite certain to be infringed if valuable. This is essentially unfair, but many affect to think that it is characteristically German.

"A nation probably has the right to enact any laws it pleases relative to patents for inventions. It may refuse foreigners protection if, as in the case of Holland, it deems this wise policy. On the other hand it may, as in the case of England, grant practically any patent application filed, leaving the question of novelty and of the inventor's right to be determined by the courts. Germany, however, subjects an inventor's application to a very strict examination, often rejecting claims which other countries grant after like examination. It will not give a patent unless it can find no reason for refusing it. It charges large fees for the rights it accords, and, having entered into a contractual relation with an inventor, it would seem morally bound to protect him, at least against infringement by German subjects. That it not only does not do this, but that in such conspicuous instances as Krupp and the Harvey armor-plate patents, Slaby and the Marconi patents, and many others, it favors rank injustice through the machinery of its civil courts, is not creditable to its standards of public morality."

Our contemporary might also have cited the cases of the incandescent lamp patents and the Tesla polyphase patents; possibly now also the Pupin patents.

CURRENT NEWS AND NOTES.

ELECTRIC POWER IN THE YUKON.—The Yukon Electrical Company proposes to furnish the copper mines in the vicinity of White Horse with electrical power. If the plan is carried out the present machinery will be replaced by polyphase machinery to supply current, also for the present lighting circuits.

DISTRIBUTED INDUCTANCE IN TRANSMISSION LINES.—As is well known, if inductance is placed in a transmission line carrying leading currents, the effect is to cause the e. m. f. at the receiving end of the line to have a value higher than the impressed e. m. f. In a patent issued April 8 to J. E. Woodbridge, the patentee states that he has discovered that if the inductance is distributed rather than localized at the receiving end in accordance with present custom, a uniform boosting effect may be produced over the whole length of the transmission line. The drawing represents a circuit having inductance coils distributed at intervals in the line. One of the claims of the patent appears to claim quite broadly this use of distributed inductance, the claim reading "The combination of a source of alternating-currents, transmitting lines, extending therefrom, inductance coils located at intervals in said lines, and a source of leading current connected to the receiving end of the transmission line."

SINGLE GENERATOR THREE-WIRE SYSTEM.—A patent issued April 8 to C. P. Steinmetz relates to the Dobrowolski system whereby from a single direct-current machine the ordinary three-wire system may be realized. In this system an inductance coil is connected across the two brushes of the direct-current machines, the middle point of the coil being an image of the neutral point of the winding. From this neutral point a wire is led, which corresponds to the neutral conductor of the three-wire or Edison system. The specification states that as this method is ordinarily applied, trouble frequently arises when unbalanced loads are either thrown on or off the system, as for example, when a motor is started on one side of the system. To obviate this objection two inductance coils are placed in parallel with the brushes, and a neutral for the lighting load led from the middle point of one coil and a neutral for the motor load, led from the middle point of the second coil. With this arrangement it is stated that lamps connected with one of the neutral conductors are comparatively unaffected by sudden changes in the load connected with the other neutral.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary George F. Porter sends us the following data as to the May Convention: Advices from various sources lead us to believe that our coming convention, to be held at Cincinnati, May 20-22, will be more largely attended than any ever held by this association. Not only has there been a great increase in our actual membership, but more non-members are inquiring about the meeting than ever before, many of them expressing an intention to join the association at that time. Our programme will include fewer technical papers than usual, but fifteen or twenty topics of practical interest to central station managers have been selected, and competent men asked to prepare discussions upon them. These discussions will be printed before the meeting and brought up there for further consideration by all our members. A few of them are as follows: "Rates," "Hot-water *vs.* Steam Heating," "Free Lamp Renewals," "Loose-Leaf Ledgers," "Uniform Accounting," "Three-Phase *vs.* Two-Phase for City Distribution," "Improvement Desired in Meters," "Caring for Consumers' Complaints." Other topics will be announced as soon as arrangements are perfected for their discussion. This method of making up our programme is sure to render the meeting most attractive, and will result, we are convinced, in practical benefit to all our members. The meetings will be held in the Grand Hotel, the headquarters of the convention. The Central Passenger Association has granted a rate of a fare and one-third from all points in its territory to Cincinnati and return, and the other associations will, undoubtedly, grant the same rate, due notice of which will be given.

NEW YORK ELECTRICAL SOCIETY.—The 224th meeting of the New York Electrical Society will be held at the College of the City of New York, Lexington avenue and 23d street, Wednesday, April 23, at 8 P. M. Mr. Caryl D. Haskins, of the meter department, General Electric Company, Schenectady, N. Y., will lecture on Electric Meters. The lecture will be illustrated by lantern slides.

TWO HUNDRED MILES AN HOUR.—A special telegram from Trenton, N. J., of April 12, says: New life was given to the proposition to have quick passage between Philadelphia and New York on an elevated trolley road, which will ignore crossings and small communities. The original American Elevated Railroad Company has increased its capital stock from $5,000,000 to $10,000,000. The company proposes to construct an air line between New York and Philadelphia at an elevation which will give clear passage across the state. The speed is to be 150 to 200 miles per hour. It is currently reported that the line has control of the franchise recently granted to the Trenton and New Brunswick Traction Company, which completes the connection between Trenton and New York.

ALTERNATING CURRENT STORAGE BATTERY CHARGING.—A radical system for the charging of storage batteries is the subject of a patent granted April 8, to R. E. Ball, alternating currents being employed. The method consists in throwing in and out cells during an alternation, according to the variation of alternating e. m. f.; that is to say, when the alternating e. m. f. is, say, three volts, one cell is thrown in, and as the e. m. f. increases more cells are thrown in until at the peak the entire battery is in circuit; as the e. m. f. begins to fall, the cells are cut out in reverse order. The negative side of the wave is then commutated, and the same operation is repeated, the cells, however, being cut in and out in reverse sequence to what they were on the positive wave. The apparatus to accomplish this object consists of a complicated commutator driven by a synchronous motor.

ARC LAMP CONTROL.—A system for cutting constant-current arc lamps in and out at predetermined times, is the subject of two patents issued April 8 to Eustace Oxley. Arc lamps to be thus controlled on two or three-wire circuits are provided with an electromagnetic mechanism, which is operated when one of the line wires is grounded. A magnet of the mechanism has one side grounded, and when one of the line wires is grounded a current flows through this magnet, thereby bringing into play mechanism which cuts out the lamp. A second patent applies to arc circuits supplied by a Brush, Thomson-Houston or other open coil dynamo, which admits of being short-circuited. In this case each lamp to be controlled is supplied with an electromagnetic mechanism, which acts when the arc generator is short-circuited. The device is made selective by the addition of a ratchet wheel to the mechanism, whereby lamps may be cut out of circuit at different hours, depending upon the number of times the machine has been short-circuited.

CONVERSAZIONE AT INDIANA UNIVERSITY. — The Physics Department of Indiana University held a conversazione during the session of the Southern Indiana Teachers' Association, at Bloomington, Ind., April 3, 4 and 5, 1902. There were six demonstrations witnessed by more than 2,500 visitors. Each demonstration required ten minutes, and was repeated six times. The following exhibits were given: The Wehnelt interrupter and Roentgen rays. A new form of Wehnelt interrupter and circuit maker (described in these columns, March 1, 1902) was used to operate the Roentgen tubes of the highest power. The gyroscope principle, illustrated by means of the bicycle wheel. A complete series of lamps, illustrating the history and development of the subject, from the grease-pan to the Nernst-lamp. Two types of the latter were exhibited. The Hewitt vapor lamp. By consent of the inventor lamps of various forms and sizes were constructed and exhibited. One of the most successful and brilliant used but 20 watts. In a demonstration with a speaking arc, no capacity was used, but the inductance was made very large. The microphone shunt-circuit carried from one to four amperes, and the arc was run at about 12 amperes. The Marconi system of wireless telegraphy was used in sending signals, starting machinery, etc.

TEST OF RITCHIE TELAUTOGRAPH.—A Paris correspondent writes to us that the despatch which we noticed in our issue of March 15th, referring to experiments with a telautograph, related to tests made with the Ritchie telautograph. A description in full detail of this interesting apparatus appeared in our issue of Dec. 8, 1900, including illustrations of all its details. Our correspondent writes that the tests were made over two looped telephone lines, from Paris to Lyons, a distance of 320 miles. A loop was made between the lines at Lyons, and the transmitter and receiver were installed in Paris at the ends of the 640-mile circuit, in order that both pieces of apparatus could be accurately observed. This is the longest distance over which the instruments have been tested. At the beginning the tests were not satisfactory, and it was found that this was due to induction from telegraphic circuits. M. Claude had predicted the possibility of such disturbance a year ago. To test the cause of the unsatisfactory working, a telephone was connected to the line, and it was found that the telegraphic signals were plainly audible. A test then was made during a time when these disturbing influences were not present, using 15,000 ohms in circuit, and the transmission of writing became very satisfactory; the signatures transmitted duplicating exactly the originals.

SPRAGUE MULTIPLE UNIT SYSTEM.—The third of three principal patents on the Sprague multiple-unit system was issued April 1. The first of this series was granted in October, 1900, and related more particularly to the fundamental principles of the system. The second patent, granted on the same date, dealt with details, and particularly with the individual throttling of the various equipments in the train. The patent just issued is for alternative devices and connections of the general scheme of multiple-unit control, and covers the new features of the equipment used in the Brooklyn Elevated Railway, which are in many respects departures from those used when the system was first applied in Chicago. The patent carries 99 claims, these bringing the aggregate of claims of the three principal Sprague patents on multiple-unit control up to almost 400. Owing to the great detail of the recent patent, mention can be made in the space here allowed of only its principal features. The main features of invention in the present patent, which also constitute the differences between it and the system of the former patents are nine in number, as follows: First, a rheostat cylinder which operates in one direction only, with or without means for giving to this cylinder an interrupted or step-by-step movement, or both. Second, a rheostat combined with an independently mounted and independently moving series multiple switch, to which combination may also be added an independently mounted and independently movable reverser-switch. Third, a combination by means of which it is possible to effect by four wires substantially everything effected in the earlier system with five train wires, one speed-determining wire of the old combination being dropped. According to this present invention the rheostat may be operated by a pilot-motor, there being a limit switch for the motor and a circuit-changing switch for the series-parallel switch or the reverser switch, or both. Fourth, means for opening the reverser or series multiple switch, or both, independently of the position of the rheostat, with or without means such as a cut-out switch on the rheostat, for preventing the closure of the reverser switch or the series multiple switch, except in certain positions of the rheostat. Fifth, independent series-multiple and reverser switches having both like or opposed movements relative to each other, with or without automatic return to open position, and with or without a rheostat having a like automatic return to open position. Sixth, various other combinations of these devices into unitary devices. Seventh, a method of operating the reverser switch, series-multiple switch and the rheostat, whereby the circuit is opened in passing from series to multiple position. Eighth, a permanent shunt with the field of a series motor in combination with the circuit-changing devices, to hold the field and reduce the arc in breaking circuit. Ninth, a three-way cut-off between the train line, the operator switches and the governing system on each car, whereby any one of these elements can be cut off without disconnecting the other two, and whereby both the governing system and the operator switches can be cut off without impairing the train line. The application for the present patent was filed Dec. 16, 1898. The specifications are accompanied by 26 figures, and unlike the case of most patent specifications, a clear idea of the system as a whole may be obtained from their reading.

TRAIN LIGHTING.—The Pennsylvania Railroad has put in service out of Pittsburg a train lighted throughout with electricity, generated by storage batteries under each car. The present batteries will supply lights for twelve hours, and improvements are expected to be made whereby batteries can be installed that will furnish lights for twenty-four hours. It is said that all the through equipment of the Pennsylvania Railroad will be furnished with these electric storage batteries.

ROYAL TELEPHONES.— According to a recent cable despatch from London, Buckingham Palace is being fitted with a complete telephone service, communicating with the nearest police and fire stations, the King's apothecary and the residence of the Prince of Wales. When a confidential message is sent by telephone between royalties it is invariably transmitted in a cipher code known only to members of the royal family and a few privileged officials. The codes are kept in small books, metal mounted, and with patent locks.

LETTERS TO THE EDITORS.

An Electrical Board of Arbitration.

To the Editors of Electrical World and Engineer:

Sirs:—It is a well-known fact that in spite of the best drawn plans and specifications, and contracts, disputes have frequently occurred in the past between parties to such contracts; and that similar disputes are bound to arise in the future goes without saying. It has occurred to the writer, therefore, that it might interest American engineers and manufacturers to learn that the representative electro-technical society in Austria, the Elektrotechnischer Verein in Vienna, has recently established a permanent tribunal, or Board of Arbitration, with the object of making it possible to secure an entirely impartial and technically accurate settlement of disputes in electro-technical matters.

The Board consists of twenty members, elected for three years, and is made up of representative manufacturers, electrical engineers and scientists. From this body of twenty, the parties to the disputes may select their arbitrators. The Austrian society hopes that all cases of dispute relating to contracts on electro-technical work and deliveries will, in the future be submitted to the above-mentioned tribunal as their forum.

Boards of arbitration have already been established in a number of trades and industries in the United States, and it has therefore occurred to the writer that possibly a tribunal of similar nature might be of benefit to the electrical industries. If such a Board is to be constituted, there is no doubt that the American Institute of Electrical Engineers, as the representative electro-technical society of the United States, would be the organization from which such a project would best emanate, and which would carry the greatest weight among all parties interested in electrical work. That it is no difficult matter to get together the manufacturer, the consulting engineer, and the user, and to have them agree upon terms, is shown by the admirable set of rules governing the quality and performance of electrical apparatus, prepared by the Committee on Standardization of the American Institute of Electrical Engineers, and adopted by the Institute in 1899.

It goes without saying, of course, that a tribunal of this nature would have no possible jurisdiction in disputes arising over patent matters and cognate subjects, which can alone be settled by the regularly established courts of law.

The writer cannot help thinking that a tribunal such as outlined would have plenty to do, and that parties resorting to it would have their cases adjudicated in an expeditious manner, at a small cost, by a body of men thoroughly conversant with the technics and economics of each case.

New York City. Joseph Wetzler.

Mr. Marconi and His Critics.

To the Editors of Electrical World and Enigneer:

Sirs: In my letter, published in your issue of last week, I have, I find, omitted to mention one point to which I desired to call attention. I refer to the question of the possibility of interference with tuned wireless messages. So far, I have not heard of any complaint on this score being made on behalf of Mr. Marconi or his companies, though Professor Slaby and his collaborator, whose claim also is to have devised a syntonic system, seem to be unable to avoid interference with their messages, not only by the ordinary working of Marconi stations, but by the working of other wireless telegraphic apparatus, which is installed, it appears, in the vicinity of Cuxhaven and is controlled by countrymen of their own. I pass over the charges of malicious "jamming" which, upon the occasion of the *Deutschland* incident, it was not scrupled to bring forward. So far as these concerned the operations of the Marconi stations it was sufficiently answered by Mr. Marconi when he remarked that, to put it on no other ground, the time of his companies was far too valuable to be wasted over such childish nonsense. If, therefore, the Slaby-d'Arco method is not capable, as it is demonstrated that it is not, of eliminating such external interference, the fact merely proves its inadequacy as compared with that employed by Mr. Marconi, who since his introduction of his own method, has found himself perfectly able to protect his messages, from all such outside disturbance. An excellent illustration of the effectual nature of this protection, which, I think, can hardly have been sufficiently appreciated by the writer of a paragraph on the "Wireless Telegraph Situation" in the recent number of Electrical World and Engineer, was furnished in the course of Mr. Marconi's recent long-distance tests on board the *Philadelphia.* On that occasion he received messages from his Cornwall station over distances varying from 250 to 1557 miles. During the whole time covered by these tests several ships carrying the ordinary standard installation of his system were within the radius over which the messages were received by Mr. Marconi on board the *Philadelphia.* The *Umbria,* notably, throughout the voyage was steaming at a distance of several hundred miles behind the *Philadelphia,* and lay therefore all the time between that vessel and the transmitting station, to which it was accordingly nearer than was the *Philadelphia.* The operator on the *Umbria* tried every device which his experience could suggest to tap any messages which might be passing through the ether, but neither the *Umbria's* operator nor any of the operators on other ships within the radius was able to induce his apparatus to respond to so much as a single dot of the messages which, however, continued to fly nimbly over them and were recorded accurately by Mr. Marconi's tuned receiver. In view of this result, even though it stood alone, which it is, in fact, far from doing, I must consider somewhat unfair the statement of the writer of the paragraph to which I have before referred that "it (Mr. Marconi's syntonic method) has never yet accomplished anything on a material scale." If we are to understand by a "perfect syntonic method" a method by which "wireless telegraphic messages can be transmitted in such manner that by no possible combination of accident or malice shall they be liable to the least interference from any point outside the walls of the transmitting station," then it is clear that no such method is in existence, and certainly no claim to have discovered such has at any time been put forward by Mr. Marconi. But I submit that a scale of this degree of absoluteness is not quite the just scale to apply with a view to measuring the exact value of what Mr. Marconi's syntonic method does actually accomplish. It is surely a little early in the day to ask of the Marconi system that it should not only offer no more liability to interference than is possessed by the cable system, but that it should offer actually less.

So far as my apprehension of the situation goes, Mr. Marconi's claim for his syntonic method, a claim which many very severe tests have gone to substantiate, is that by means of it his system of wireless telegraphy is put in respect of all such outside disturbances, adjacent trolley car work, and the like, on an identical footing with the existing cable system. Criticism, then, based on the absence of a still further claim by Mr. Marconi to go beyond this point of security were surely a little ungracious.

Of interference, however, with the work of one by that of another of his own stations, even when they are quite close together, Mr. Marconi's experience has demonstrated that he has no reason whatever to be afraid. The German suggestion, in particular, that his transoceanic work will in the least interfere with, much less "paralyze," wireless communication between ships or between ship and shore within the radius over which the long-distance messages are sent is completely disproved by the *Philadelphia* tests and I may mention, in further illustration of the same point, that the ordinary standard apparatus at the Lizard station, only some six miles distant from the big power transatlantic station at Poldhu, is, at the will of the operator, completely cut off from all sensitiveness to the etheric waves generated at, and transmitted from, the latter.

There remains the question of malicious interference, and I scarcely

suppose that in this, either, Mr. Marconi need find very much to alarm him. I do not know how the law may stand in America, but in England, at any rate, I think the promoters of any such wilful disturbance would find in those same "common-law rights of the first comer" alluded to by Mr. Marconi, a somewhat formidable obstacle to get over. And pending the arrival of that international regulation of the matter which we are promised, I fancy that once the public, whether American or British, has had time to realize the advantages of the transoceanic wireless telegraphy at comparatively cheap rates, which it is hoped will now shortly be placed at its disposal, the popular feeling on both sides will be too strongly in its favor to allow anything of the kind to be practiced upon a serious scale.

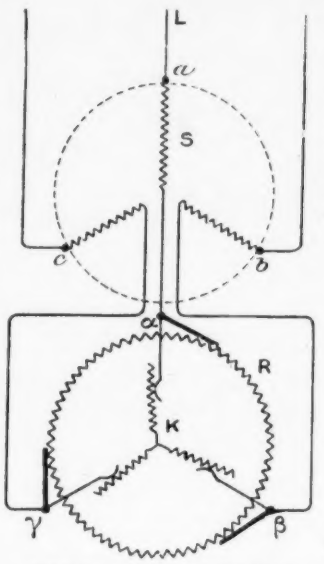
NEW YORK CITY. WILFRID BLAYDES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Parallel Operation of Alternators.—LINCOLN.—A Franklin Inst. paper. He gives a mechanical analogy of the operation of alternators in parallel. A bank of alternators taking mechanical power from their prime movers and supplying electrical power to a common bus bar, is analogous to a bank of spur gears also taking power from prime movers and supplying it through these gears to a common shaft. This line shaft is the mechanical analogue of the bus bars and the spur gears of the alternator. For successful operation in parallel the load should be properly divided; for this, the prime movers are to be provided with governors of such a type that the speed falls as the load increases. Proportional division of load, while desirable, is not an absolute essential to the successful operation of many plants. Freedom from hunting is an essential. Hunting in synchronous machines is the oscillation of the armature masses accelerated and retarded above and below normal average speed. Hunting can be prevented therefor either by removing the synchronous force tending to keep alive the oscillating motion, or by providing "electric friction," tending to destroy such motion if once started. Probably the most potent factor in keeping alive hunting is found in the steam engine governor as usually installed. Hunting induces or tends to induce in certain governors a synchronous force to keep itself alive. The remedy to this action is to make the time between a movement of the governor balls and its application of the corrective force, greater than the time of a half cycle in the period of oscillation. The remedy involves the prolongation of the time of response to motion of governor balls. This object may be accomplished by the aid of properly designed dash-pots. The uneven torque at different points in an engine cycle may give rise to hunting if the natural period of oscillation is synchronous with the engine impulses. One remedy for this difficulty is to synchronize engines as well as alternators, so that at any instant each engine is in a similar part of its cycle. Another remedy lies in the addition of fly-wheel capacity. The second prevention for hunting lies in so designing the alternating machines, that as soon as hunting occurs, a resisting force of a frictional nature is set up tending to destroy the oscillation. This electric friction is produced by surrounding the field poles, especially near the tips, with a band of copper. He has found cases in practice in which the hunting could be ascribed neither to the irregularity of torque in the prime mover, nor to the action of the governor, in all of these cases some part of the electric system—not necessarily that in which hunting was most noticeable—contained synchronous machines with laminated poles and no damping devices. He finally discusses the methods and apparatus used for throwing alternators in parallel. He describes the use of the synchronizing lamp, the use of synchronizing voltmeters, Woodbridge's method, and his own phase-indicator for synchronizing, which has already been described.—*Jour. Frank. Inst.*, April.

Self-Exciting Series Alternator.—LATOUR.—After describing his self-exciting shunt alternator, which was noticed recently in the Digest, he describes his self-exciting series alternator. This alternator consists of a secondary stator S, connected in star, and of a primary rotor R in series with it. A rheostat K for excitation is normally in parallel with the rotor. The synchronous running of such a machine is assured for a given inductive or non-inductive load by a very accurate adjustment of the brushes, this adjustment depending only on the power factor, but not otherwise on the load. When the rheostat K has a resistance of the same order of magnitude as the winding, the rotor can be considered to be short-circuited by means of the brushes through a small non-inductive resistance; this gives the best damping for the higher harmonics.



SELF-EXCITING ALTERNATOR.

Concerning commutation, the most favorable conditions are fufilled when the field of the machine is approximately fixed with regard to the rotor, and when the harmonics of the field are annulled. The alternator operates on a constant current distribution network. Synchronism and a power factor, equal to unity, are maintained at varying load by adjusting both the rheostat K and the brushes. The advantages of a current system are well known for direct current from Thury's system. Leblanc has pointed out its advantages for the alternating current. But for polyphase current a constant system does not seem practical on account of certain difficulties. His series alternator is therefore more of theoretical interest, because it leads to his compound motor.—*L. Ind. Elec.*; March 10.

Sparking at the Brushes.—A. L. RICE.—An illustrated article on sparking, its causes and cure. The current should be zero when the bar leaves the brush. This is ordinarily accomplished by so placing the brush on the commutator that the self-induction effect tending to prolong the current in a coil is neutralized by a back e. m. f. set up in the coil as it enters the weak magnetic field under the following pole tip. If the poles are all of the same strength and all have similar distribution of magnetism, and if all coils of the armature have the same amount of self-induction, both of which conditions should obtain in a well-designed machine, the brushes being set symmetrically around the commutator, may all be shifted back and forth together until sparking disappears. He discusses the trouble due to a high or low bar, to wearing away of the bars, leaving the mica insulation in ridges, to getting out of round owing to poor construction of the commutator or unequal wear or to cutting from a rough brush or from previous sparking induced by other causes than roughness. When one set of brushes shows sparking, and a shifting of the rocker ring changes the sparking to another set, the probability is that there is a wrong setting of the brushes. He then discusses the troubles due to windings of field or armature. If one set of brushes is giving trouble, the difficulty is probably in an unequal distribution of magnetism in the field opposite that brush. The most probable trouble is the short-circuiting of part of the field-coil due to defective insulation. This can be tested by measuring the voltage drop over each coil with a voltmeter. The uneven distribution may also be due to a poorly made joint or to a difference in the iron of the several pole pieces; this can be tested with an exploring coil and a galvanometer. Another point to be investigated in a compound-wound machine, is whether the series and shunt coils are acting together or not. A loose commutator connection or a broken armature coil

often produces a flash, as the bar to which it is connected passes each set of brushes, in much the same way as a very high bar. As a temporary remedy the bar affected may be short-circuited by a piece of copper bridged across the insulation to the one next it on either side, but a new coil should be inserted or the connection repaired as soon as possible. If a machine shows any tendency to spark, it should be carefully guarded from having to carry overload.—*The Eng.*, April. 1.

REFERENCE.

Operation of Two or More Dynamos Together.—McCormick.—An article in which he discusses, by simple algebra, the arrangement of dynamos working together, formulas being given for three cases: dynamos in parallel, the three-wire system, and dynamos in series.—*Elec. Rev.*, April 5.

Lights and Lighting.

Enclosed Arc Lamp.—Donath.—An illustrated article on the theory of the Regina enclosed arc lamp. Wedding found that the lamp consumes on the average 1,075 watts per average spherical candle, while other types of enclosed arc lamps consume on the average 2.5 watts per candle. The Regina lamp is distinguished from other enclosed arc lamps by the method of leading the carbons through the globe and by the method of regulating the supply of oxygen, as has already been described in the Digest. He confirmed Wedding's result. The Regina arc lamp therefore consumes even less energy than an open arc lamp giving the same illumination, as the latter consumes on the average 1.65 watts per candle. He made experiments concerning the photographic actinity of the lamp, which was found to be excellent in comparison with other arc lamps. He believes that the higher efficiency of this lamp is due to the greater emission of light by the arc. When projected upon a white screen, the arc is intensely light, while with other lamps it is relatively dark compared with the carbons. "Evidently the discharge in the enclosed space approximates that in a slightly evacuated Geissler tube." The air inside the globe is poor of oxygen and very rarefied on account of the high temperature. When the lamp has produced this condition the emission of light increases on account of the increasing temperature of the carbon and of the part which the arc then takes in the emission of light. With the temperature the actinity also increases.—*Elek. Zeit.*, Mar. 13.

Power.

The Misuse of Coal.—John Perry.—A vehement plea against the misuse of coal. In the best steam engines less than 10 per cent. of the energy of coal is utilized; in many small engines only 1 per cent. The great waste of energy inevitable in all heat engines of the world is enormous. It is known that when fuel energy is converted into the electric form directly, as in a voltaic cell, more than 90 per cent. of the fuel energy is convertible into the mechanical form, but at present contrivances to do this even in the case of gaseous fuel are too bulky and expensive to compete with heat engines. He suggest that an organized attempt be made to convert the energy of coal into electrical energy in some form of engine which shall not cost more or have greater weight than a steam engine of the same power. "Many men have advanced the subject beyond its first principles; they know of directions in which to work with prospects of success. In the animal machine the thing is actually done; but of this machine the mere conversion of fuel energy into mechanical work is not the most important function, and the machine is very complex. Still, in it we have no heat engine, but the sort of thing we are looking for. . . . The writer feels sure that if one or two chiefs like Lord Kelvin or Lord Rayleigh were entrusted with the expenditure of a million a year for two or three years by the English nation for the benefit of the world, with power to impress the service of all scientific workers lilkely to be of use, to make their operations as extended as they pleased, they would bring the invention within reach of the ordinary engineer."—*Nature*, Mar. 20; Lond. *Elec.*, March 28.

An editorial note on Perry's suggestion, which is not looked upon favorably, while the invention of such an engine is highly desirable, it is said that the inefficiency of the heat engine is not to be blamed "for all the impending troubles." By far the largest proportion of coal is used, not for heat engines at all, but for metallurgical and other similar furnaces, and for heating buildings.—Lond. *Elec.*, March 28.

Electric Power Supply.—Brown.—A paper read before the Newcastle section of the (Brit.) Inst. of Elec. Eng. on "electric power supply on the Northeast coast." He thinks that at no distant date the steam turbine will be a strong competitor for first place in the equipment, especially in view of the very marked economy at full load and overload which was demonstrated in the recent experiments at Elberfeld. The combination of blast furnace gas and the boilers in a generating station of 30,000 hp should be able to allow an economy of production which is hard to exceed with coal-fired boilers. The use of gas engines of large power is strongly advocated by many, but beyond powers of 1,000 or 1,500 hp the gas engine maker has not yet shown that it would be possible to equip an electric power system with units of 4,000 to 5,000 kw. The system of distribution along the trunk mains should undoubtedly be by three-phase currents. He is inclined to the adoption of 40 periods as a standard unless the supply is entirely for power purposes, when probably 25 periods is better. Ten thousand volts should be the minimum pressure at which any generating station should generate and distribute along its trunk cables. The question whether it is less costly to generate from say, one large plant with 25,000 to 30,000 hp installed, than from say five plants each of 5,000 to 6,000 hp, is answered decidedly in the affirmative, provided the larger station is equipped with relatively larger units, but not if small units of 500 to 1,000 kw are installed. He advocates standardizing frequency and pressure.—Lond. *Elec. Eng.*, March 21.

REFERENCE.

High Tension Electric Power Transmission.—Gibson.—An illustrated review of the progress made in high tension transmission in recent years, with a description of various typical modern transmission plants.—*Eng. Mag.*, April.

Traction.

Electric Traction.—An editorial discussion of the paper of Swinburne, recently abstracted in the Digest. The writer agrees with Swinburne that the tramway system should not be extended to meet the case of a long main railway or of a crowded suburban line. In no case has tramway practice been adopted in operating metropolitan railways either in Europe or in America. Trains with larger motors and some sort of multiple-unit control, or hauled by locomotives, have been used, and no overhead wires have been employed. Doubt is expressed whether any experimental manufacturer would care to build a 3,000-volt 250-hp traction motor. While Swinburne seems rather favorably inclined towards the constant current system, it is said that this has been tried and abandoned and cannot be recommended. The problem in Great Britain at present is the electrification of the suburban lines in the large cities. This has nothing to do whatever with the electric equipment of long train lines. It would be very wrong to think that in the electrification of suburban lines the chief point to be considered is to make the system there adopted, fit in with that which might eventually be used on our main lines. This will not only lead to the retardation of the equipment of the suburban lines, but may also cause the wrong system to be employed.—Lond. *Elec. Rev.*, March 28.

REFERENCES.

Cleveland.—Woodward.—An illustrated article on the evolution of electric railway power plant apparatus, as illustrated by the Cedar Avenue Station of the Cleveland Electric Ry. Co.—*The Eng.*, April 1.

St. Louis.—An illustrated description of the power plants of the St. Louis Transit Co., which controls the entire street railway system of the city and its suburbs, aggregating about 360 miles.—*Eng. News*, April 3.

London.—Robinson.—A long abstract of a paper, read before the Society of Arts, on "electric traction: London's tubes, trams and trains, 1901." The paper is divided into three parts, the past, the present ,the future.—Lond. *Elec.*, March 28.

Installations. Systems and Appliances.

Influence of Tariffs on Electricity Supply.—Baker.—An article giving the results of statistical comparisons. The conclusion reached is as follows: The general moral is that the flat rate system is the only one at present in general use which may be considered satisfactory all round to both consumer and producer. "There remains the fact, however, that that valuable by-product, the day load, is still a glut in the market, and that if a sale is to be found for

cheap electricity out of peak-hours, a method of charging must be adopted which will enable the consumer not only to ascertain by estimation in advance or direct inspection the amount of his liability, but will, as in the little tried Kapp system, enable him to know when and at what rate the cheap supply obtains." Such methods, with a method of charging, which the consumer is able to understand, and by which he is able at any time to ascertain the amount of his bill to date, would build up a day-load.—Lond. *Elec. Rev.*, March 21, 28.

Nelson.—An illustrated article of the new municipal plant of this British town, which has been built on land adjoining the refuse destructor ,the system being changed over from the two-wire 110-volt system to the three-wire 2 x 230-volt system. The steam from the destructor is utilized for the traction day-load, and the generating plant is available for both traction and lighting. The generating plant consists of three 200 kw steam dynamos and a battery of 268 cells, giving 137 amps. for 10 hours and 263 for 3 hours.—Lond. *Elec. Rev.*, March 28.

REFERENCES.

Central Station Losses.—An article in which several rules and suggestions are given to show how by skilled supervision and by special means, the cost in central stations can be reduced. This refers to the mechanical part of the plant.—*Lond. Elec. Rev.*, March 28.

Electricity in Greece.—JACKSON.—An illustrated review of the development of light and power stations and electric tramways in Greece.—*Cassier's Mag.*, April.

British Central Station Statistics.—A very large table, giving in 21 columns a list of electricity supply works of the United Kingdom, with a large amount of special information concerning system and plant employed.—*Supplement to Lond. Elec. Rev.*, Mar. 28.

ELECTRO-PHYSICS AND MAGNETISM

Electric Waves.—LORD RAYLEIGH.—An abstract of a Royal Institution lecture in which he first dealt with the resonance between electric circuits. By Lodge's experiment of the syntonic jars, he showed that tuning of some accuracy is necessary to obtain good resonance, and that this tuning can easily be effected by altering the self-induction of the receiving circuit. He investigated theoretically the following interesting particular case. Imagine a long circuit to one point of which is applied a periodic e. m. f. of a certain frequency. At a second point, where power is being absorbed, an e. m. f. nearly opposite is applied, and if the circuit be an oscillatory circuit with a rate of its own, this second e. m. f. "may be arranged to tune the circuit and reduce it, as it were, to one possessing resistance merely." But if, instead of absorbing power directly from the first circuit, the power be absorbed from a parallel tuned circuit, the e. m. f. introduced being chosen suitably, then he found that just as much and no less power will be obtained from the second circuit as was obtained directly from the first, however small the mutual inductance is between the two circuits. He then discussed the effect of the curvature of the earth on wireless telegraphy; there is a continuous bending of the path of radiation; this cannot be due to refraction by the atmosphere. If due to diffraction, it would be a species of diffraction quite distinct from that studied in optics, where the bending takes place at a sharp edge. If the optical analogy be sought, then, taking the wave length of the electromagnetic disturbance as 1,000 ft. and that of light as 0.000025 in., a source of light on the surface of a sphere 1 in. in diameter would be a parallel case. It seemed improbable that light could creep round the sphere to a point 90 degrees distant. Of course, the wavelength of the electromagnetic disturbance might be made large by increasing the capacity of the sending apparatus, but the danger then arises "that grip on the ether may be nearly lost."—Lond. *Elec.*, March 21.

Ionic Induction.—HERTHA AYRTON.—A description of various experiments in which an electroscope is discharged or charged by means of a charged body placed at a distance. This most striking experiment is that in which a positively charged glass rod is brought to within 200 c. c. of an uncharged electroscope; a candle, also positively charged, is placed between the rod and the electroscope, but nearer to the rod; the leaves then diverge, and the electroscope is found to have acquired a positive charge. The candle can be replaced by an insulated saucer of cotton wool saturated in turn with ether, methylated spirits and dilute sulphuric acid placed at a distance from the electroscope but not by dry carbon dust. A red-hot platinum wire is capable of discharging an electroscope at a distance of 300 cm.—*Nature*, Feb. 27; abstracted in Lond. *Elec.*, March 14.

Recombination of Ions.—LANGEVIN.—An account of an investigation in which he verified the numerical value of Townsend's recombination co-efficient by an entirely independent method. His method consists in creating a uniform field in the gas between two parallel plates and finding the quantity of electricity induced upon one of these plates at the moment when the field is created; also the quantity collected by this plate after the passage of a single Roentgen discharge, and the quantity liberated in the gas by the radiation, and collected in an infinite field. The difference between the two last quantities is due to the recombination of ions.—*Comptes Rendus*, Mar. 3; abstracted in *Lond. Elec.*, Mar. 21.

Spontaneous Ionization of Air.—RUTHERFORD AND ALLEN.—An account of experiments on the spontaneous ionization of air. An insulated charged conductor placed in a sealed tube loses its charge gradually, owing to the spontaneous ionization of the air in the table. Wilson has calculated that about 19 "ions" are formed per second in every cubic centimeter of gas. The present authors deduce from their own experiments the number 15, which is very close to Wilson's result.—*Phys. Zeit.*, Mar. 1; abstracted in *Lond. Elec.*, March 14.

Distribution of Current at the Surface of Cathodes in Vacuum Tubes.—WEHNELT.—An illustrated account of experiments which gave the following results. When the cathode is not completely covered with glow-light, the current flows only through those portions which are covered with glow-light. In cylindrical discharge tubes with circular cathodes normal to the axis at low pressures. the current passes only through those portions to which the rays are visibly attached. The visible point of attachment of the rays at the cathode must be regarded as the origin of the cathode rays.—*Ann. der Phys., No. 2;* translated in Lond. *Elec.*, March 14.

Atmospheric Electricity.—GEITEL.—An abstract of a Hamburg Scientific Congress paper. The general result of atmospheric observations to date show that the earth has a permanent negative charge, and the atmosphere a permanent positive charge. The latter is greatest in the case of fog, which probably prevents a great number of the heavier positive ions from reaching the surface of the earth. The source of ionization may be ultraviolet light of the sun, but he prefers to seek it in the spontaneous ionization of the air. The negative ions, many of which are, no doubt, free electrons, reach the earth's surface sooner on account of their superior mobility, and the negative charge thus imparted to the earth is kept from growing indefinitely by the repelling action exerted by it upon the negative ions. The conductivity of the air is greatest where the air is purest, *i. e.*, in mountains or in high latitudes, on account of the superior mobility of the ions in pure air.—Lond. *Elec.*, March. 14.

REFERENCES.

Ionization.—STARK.—An abstract of an article on ionization of gases by ionic shock. After general remarks on the moving ions, he discusses ionization in the interior of a gas and in the limiting surface of a gas, double and simple frontier ionization at the anode, and ionization in the aic.—Lond. *Elec.*, March 21.

An editorial entitled, "The electric substance," gives a general review of the theory of electrons.—Lond *Elec.*, March 21.

Stratification of Hydrogen.—CROOKES.—An illustrated reprint in full of his Royal Society paper, which was recently abstracted in the DIGEST.—*Sc. Amer. Sup.*, March 29.

Theory of Electricity.—DUANE.—A mathematical paper on the boundary conditions of the electrical field.—*Phys. Rev.*, March.

Magnetostriction.—SANO.—A mathematical note on Kirchhoff's theory of magnetostriction.—*Phys. Rev.*, March.

Electromagnet.—GRAY.—An abstract of a paper read before the Glasgow section of the Brit. Inst. Elec. Eng., in which he describes a new electromagnet for magneto-optic wrok.—Lond. *Elec.*, March 21.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemical Polarization.—REED.—A Franklin Institute paper in which he first gives a review of greatly differing definitions of polarization given by numerous authors. Polarization is a phenomenon accompanying some kind of a change in the condition of an electro-chemical cell, due to the passage of an electric current.

The inevitable effect of the passage of a current is to exhaust or destroy the chemical condition or composition of the cell as it was originally composed, and to produce a cell of different composition having different electromotive force, resistance or concentration. There is an intimate connection between the progressive electro-chemical changes in a cell and its progressive polarization, which points to the conclusion that polarization is most correctly defined as a progressive change in the composition and e. m. f. of an electro-chemical system necessitated by the progressive exhaustion of one or more of the electro-chemical re-agents. All of the so-called phenomena of polarization are merely phenomena, due to electro-chemical exhaustion; that is, phenomena due to the change of substitution of a new electro-chemical system for a preceding one. He examines the intimate relation between the energy evolved or absorbed in electro-chemical reaction and the phenomena of polarization. As an example he gives the Daniell cell; while it gives current, the quantity of the copper sulphate is continually diminishing, while the quantity of zinc sulphate is continually increasing; as the current increases, the original arymmetrical system is progressively converted into a symmetrical system; during this change there is a simultaneous progressive change of the e. m. f. When the amount of copper sulphate has decreased so much that it is insufficient to transmit the current, hydrogen will be deposited instead of copper, as water is more easily decomposed than zinc sulphate. The selective tendency of a current to be transmitted by a compound requiring the minimum absorption of maximum evolution of electrical energy in preference to other equally accessible compounds, is called by him the law of maximum electrogenesis. The recognition of this law makes it evident that in every case the phenomena of polarization are merely phenomena of electro-chemical exhaustion.—*Jour. Frank. Inst.*, April.

Hargreaves-Bird Process.—Walker.—An illustrated article on the Hargreaves-Bird process for the electrolytic production of soda and bleach. It is used on a commercial scale at Middlewich, England. The cells measure internally 5 feet by 10 feet by 1 foot. The cathodes consist of copper wire cloth, each 5 feet by 10 feet, giving a total area of 100 square feet. The anodes consist of pieces of gas carbon attached to frames between the cathodes. On the inner surfaces of the cathodes and in contact with them are diaphragms, 0.25 inch thick, composed of a material the exact nature of which is not disclosed. "It is a hard and non-porous material, composed of silicates, asbestos, etc. It is not in the nature of a filtering medium, but by osmosis allows the soda to pass through to the cathode, but prevents the passage of chlorine or undecomposed salt. (How osmosis can take place through a non-porous material is not explained.) The efficiency of the diaphragm is, of course, the chief success of the process, though the arrangement of the anodes is such that they are not attacked by the chlorine, which is also an important factor. The soda on passing through the diaphragms comes into contact with an atmosphere of steam and carbonic acid, and the resulting solution of carbonate of soda trickles out at the bottom. If no carbonic acid is present the solution consists of hydrated caustic soda. The chlorine is led away to lime chambers, where bleaching powder is made. The brine is being continuously pumped through the anode chamber from the well and back again, so that the strength of the solution is maintained constant. Each cell is capable of decomposing 237 lbs. of salt in 24 hours, producing 395 lbs. of standard bleach, containing 37 per cent. of chlorine, and 578 lbs. of soda crystals. The electrical efficiency (probably meaning in ampere hours) of the cell closely approximates the theoretical. The supply of carbonic acid for the cathode chambers is at present obtained from lime-kilns, and the lime produced is utilized in the bleach chambers. The plant is favorably situated for the supply of lime ready made and limestone for use in the carbonic acid supply. It was originally intended to use the flue gases from the boiler furnaces as a source of supply, and experiments are now being made with mechanical stokers, which will produce the least amount of soot, and with scrubbers, for removing the soot, sulphur and carbon compounds. There is some likelihood also of gas engines being eventually used as a source of power for the dynamos, in which case the carbonic acid would be obtained from the exhaust, and cleansed in the same scrubbers.—*Eng. & Min. Jour.*, April 5.

Electric Energy Direct from Coal.—J. Wright.—An illustrated article, in which he first mentions Armstrong's hydro-electric machine, and then gives a review of thermopiles. This review is summed up by the statement that the thermopile is an extremely inefficient device for the production of electrical energy from heat, and also possesses several inherent defects, which renders it unsuitable for any but a few special requirements. Chief among the drawbacks of this type of generators are: firstly, its necessarily high internal resistance, owing to the fact that the hot and cool junctions must be separated by an appreciable expanse of metal; secondly, the difficulty of preserving, for any length of time, good electrical conductivity at the junction, owing to oxidation and other causes, and, thirdly, the extremely rapid depreciation of the pile, owing to the sudden extremes of temperature to which its parts are adjusted and which give rise to consequent expansion and contraction of the metal, tending to loosen all joints, and, in time, to cause the destruction of the whole pile. He then describes Tesla's and Edison's pyromagnetic generators. Both thermopiles and pyromagnetic generators have the defect that they depend on a primary combustion of coal in a furnace; this, in itself, implies considerable waste, in that many of the elementary bodies contained in the coal are either consumed or pass off in the form of vapor or gas without giving a proportionate return as heat energy. He then discusses voltaic cells with carbon anodes, and describes Reed's process, the Jacques cell and the Blumenberg cell; he mentions Grove's investigations of the gas battery and Borcher's cell. He thinks that the carbon cell or the gas battery may provide a solution of the problem. But "the apparatus will probably prove cumbersome and costly, so that although the theoretical efficiency might be as high as 70 or even 80 per cent, the great interest on capital outlay would probably be a prohibition to its commercial adoption."—*Cassier's Mag.*, April.

REFERENCES.

Storage Batteries.—Reuterdahl.—An illustrated article, in which he first gives a brief general review of the subject of electric storage cells. He then discusses the lead cell, the Plante and the Faure type, gives the theory in the sense of the ionic theory that charging consists in the transformation of bivalent lead ions into quadrivalent ions, and that discharging consists in the reverse change; he discusses the advantage of lead for storage cells and gives the conditions which a good lead storage battery should fulfill in practice. He then more briefly discusses other forms of storage battery: the lead-copper cell, the lead-zinc cell, the alkaline-zincate type, and the general type which he calls "constant concentration cells," and of which the Edison accumulator is a special example. He then discusses the regulation of storage batteries by the following four method; by the use of equalizing rheostats; by the use of counter e. m. f. cells; by the use of regulating cells, and by means of the booster system. He then gives a review of storage battery applications, and finally formulates the requirements of the future ideal storage cell.—*Cassier's Mag.*, April.

Electric Furnaces.—Blount.—The first part of a reprint in full of his paper, read before the Manchester section of the (Brit.) Inst. Elec. Eng. After a review of novel industrial products produced in the electric furnace, he describes the characteristic features of the arc and the resistance furnace, and gives an account of the history and development of the electric furnace.—*Lond. Elec.*, March 21.

Electricity and Power Direct from Heat.—Asher.—An article in which it is first suggested that thermo-electric batteries may be directly treated by the rays of the sun; "if a thermo-electric battery can transform even 2 per cent. of the total energy into electricity it might be advisable in many cases to erect large solar thermoelectric batteries." He also discusses Edison's pyromagnetic generator, Edison's pyromagnetic motor, and Menges' pyromagnetic motor-generator.—*Sc. Amer.*, March 29.

Catalytic Sulphuric Acid Process.—A long article on the development of the contact process which is now a commercial success. It is non-electric.—*Lond. Eng'ing*, March 28; an abstract of Knietsch's German paper on this process in *Eng. & Min. Jour.*, April 5.

An article by Sackur, discussing this process from the point of view of modern physical chemistry.—*Zeit. f. Elektrochemie*, Feb. 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Phase Meter for Three-Phase Circuits.—Arno.—An abstract of a paper read before the Italian Electro-technical Society. He describes a modification of the method suggested by him for measuring the phase difference in three-phase circuits by means of an ordinary wattmeter. If *A B C* represent the three conductors of the circuit, in the original method, the current coil is inserted in circuit *A*, and the pressure coil joined first between *A* and the neutral point, and then between *B* and *C*; the ratio of the two readings then gives the square

root of three times the tangent of the phase difference. The modification consists in having the pressure coil wound double. One coil is joined between *A* and *B*, and the other first between *A* and *C* and then between *C* and *A*, the two being in series in each case. The centre of the coil is then at the same voltage as the current coil, and, if the greater part of the voltage be absorbed in external resistances, there is no large difference of potential in the instrument.—*Elettricita*, Nov. 30, 1901; abstracted in *Science Abstracts*, March.

REFERENCE.

Mercury Interrupter.—An English translation in abstract of the German article on a new mercury-jet break, recently noticed in the Digest.—*Lond. Elec. Rev.*, March 21.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Submarine Cables and Coherer.—GUARINI.—The first part of an illustrated article in which he discusses the problem of using the coherer in cable telegraphy, on account of its high sensibility. This sensibility in watts is 10 to the minus 14th power, while that of an ordinary relay is 10 to the minus 6th power. The purpose would be to increase the speed of transmission, to diminish the e. m. f. required, and to diminish the section of the conductor by reducing the current required for the receiver. He first discusses an arrangement in which the coherer is in series with the line, while the relay with a local battery is in shunt with the coherer. He then discusses this arrangement together with condensers in the line. He then suggests a combination of two coherers, by which they act as two selecting relays—Lond. *Elec. Rev.*, March 21.

Type-Printing Telegraph.—A note on the Steljes type-printing telegraph, which is practically a Wheatstone A. B. C. telegraph, modified to print off the messages from a type wheel at both transmitting and receiving ends. A skilled operator can send 29 or 30 words per minute. The average current used is only 10 milliamperes, and although it is alternating, it has no effect on neighboring telephone circuits and it may even be used over a telephone line over which conversation is taking place simultaneously. In the latter case, the metallic circuit of the telephone line is bridged by a differentially-wound induction coil of about 500 ohms resistance and 11 henrys inductance, the middle point of which is connected through the type-printing telegraph to earth.—*Lond. Elec.*, March 28.

MISCELLANEOUS.

Electric Response in Plants Under Mechanical Stimulus.—BOSE.—An abstract of a paper read before the Linnean Society. There exists a perfect parallelism between the response in animal and plant tissues. There are responses exhibiting no fatigue, as in nerves; also responses exhibiting fatigue; and those which show a "staircase" effect. Swaying of a tree by wind gives rise to a radial e. m. f., the current flowing inwards. Ineffective stimuli when superposed become effective. The exact death point of a plant can be accurately determined by electric methods.—*Lond. Eng.*, March 28.

REFERENCE.

British National Physical Laboratory.—An illustrated description of the laboratory and an account of the proceedings at the opening.—*Lond. Elec. Eng.*, March 21.

New Book.

CONGRÈS INTERNATIONALE D'ÉLECTRICITÉ. Rapports et Procés-Verbaux. By M. E. Hospitalier, Rapporteur General. Paris: Gauthier-Villars. 526 pages, illustrated. Price, 20 francs.

The volume before us is divided into two sections. The first, occupying nearly two-thirds of the contents, is devoted to "Preliminary Reports" on a number of topics of importance. These preliminary reports have, in nearly every case, been prepared by men of eminence in their respective departments, and as such present a very good résumé of the state of the art in its various branches; they thus formed an excellent basis for discussion in the various sections into which the Congress was divided.

A considerable part of the time of the meetings of the official delegates was occupied by discussion on the adoption of names for the magnetic units. We note particularly the excellent work done by the American delegates of the Congress, in carrying against considerable opposition, the programme formulated by the American Institute of Electrical Engineers, namely, the designation of the C. G. S. units of magnetic field of magnetic flux, to which the names of Gauss and Maxwell were assigned. Messrs. Kennelly and Mailloux deserve especial mention in this connection owing to their successful advocacy of the measure, and Mr. Mailloux particularly, who, in the absence of Mr. Kennelly, secured at the final meeting, after a lengthy debate, a reversal of prior adverse action on the A. I. E. E. programmes.

We also note that there was quite some discussion on the question of affording protection to those distributing electrical energy, by considering it as "property"; and the Congress expressed the hope that the various governments would take action with a view to affording legal protection to current distributers.

BOOKS RECEIVED.

THE LAWS OF RADIATION AND ABSORPTION. Harper's Scientific Memoirs. Edited by D. B. Brace, Ph. D. New York: American Book Company. 131 pages, illustrated. Price, $1.00.

JAHRBUCH DER ELEKTROCHEMIE. Berichte uber die Fortschritte des Jahres, 1900. By Dr. W. Nernst and Dr. W. Borchers. Halle a. S.: Wilhelm Knapp. 596 pages, 192 illustrations. Price, 24 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Electric Railway and Signal System.

An operating model of a system of propulsion for electric railways, designed particularly for tunnel and yard work, is being exhibited by the Acmescope Company, at the works of the Garvin Machine Company, in New York. The conductors from which the motors take current are supported rigidly overhead, and are of sufficient size to carry current to operate one train on a block, each block being fed separately from the feeders; and means are employed for automatically connecting and disconnecting the feed wires from the contact bars from which the motor derives the current. There are two overhead conductors, one being used as the return. The employment of this system leaves the regular rails intact, and permits the use of a signal system which automatically connects the feed-wires to the contact conductors and disconnects them as the train leaves the block. It opens the circuit and deprives the motors of current in case

the block ahead is occupied by another car or train, or there is a broken rail, open switch or open drawbridge; and when the obstruction has been removed the circuit is closed automatically and the train proceeds. This system dispenses with all signal lights in the tunnel and in the yards, except switch lights, as each motor car or electric-locomotive carries its own signal in the cab, where it can be seen by the engineer at all times and under all conditions of weather, in tunnels and in the open.

In the operation of the track signal system, track batteries along the road are entirely dispensed with, all of the necessary current for the signals being supplied by a storage battery carried on the motor-car or locomotive. The system is operated on the closed circuit principle, and in the event of any abnormal condition along the line, cautionary or danger signals are set in the cab, where the engineer can see them at once. There is thus no danger of running by such signals; they are ever-present so long as the danger on the line exists.

The track is divided into insulated sections of any desired length, each section overlapping the one behind by means of an angle-bar or contact-rail, placed parallel to the service-rail, but raised above it. A contact-making device, carried on the locomotive, rolls over the contact-rail, thus disconnecting the signaling apparatus from the section immediately beneath the locomotive or car, and connecting it with the section ahead. At the farther end of each section the two rails are bridged by a high resistance, which, under normal conditions, reduces the current to such a degree that the signal in the cab remains inactive. Any obstruction on the section ahead, however, such as a car, short-circuits the resistance, and the consequent increase in current causes a green signal lamp in the cab to glow. A broken rail, or an open switch or draw-bridge breaks the circuit completely and causes a red lamp to flash—a broken connection anywhere in the circuit is signalized by the red lamp.

In addition to these visible signals, an audible signal—a gong—is provided. The audible signal indicates, by the number of strokes, the nature of the trouble—whether the section ahead is still occupied by a train, or whether there is an open switch or drawbridge.

It is evident from this brief description that under normal working conditions no signals will be displayed or sounded, but the moment a train enters a section that is not clear the fact is indicated at once on either the green or red signal, and by the gong, according to the nature of the obstruction. In connection with the signal system is used a recording device which makes a record of every signal made during the run, and the time of each. In the development of this system it is stated that every contingency that is ordinarily met with in railway practice has been provided for by the inventor, Mr. Robert J. Sheehy.

Breast Plate Transmitter.

For a number of years all the larger switchboards sent out by the L. M. Ericsson Company, Stockholm, Sweden, have been equipped

BREAST PLATE TRANSMITTER IN USE.

with the breast-plate transmitter, and it has been successfully demonstrated that much quicker service can be secured by their use.

As seen in the illustration, the mouthpiece on the breast plate can be adjusted to suit the operator, and is always in position whether the operator is sitting, standing or reaching out at one side. All metal parts are of aluminum to insure lightness, and a silk elastic strap with adjustable buckle allows the set to be fitted so as to suit any operator. The transmitters are being marketed in this country by the Ericsson Telephone Company, 296 Broadway, New York City.

Gas Engine Igniter.

The Holtzer-Cabot Electric Co., of Boston, Mass., has recently designed and placed upon the market a new gas engine igniter of the dynamo type, which has several distinctive features, the most important of which are that it does not require the use of a spark coil and is quite independent of speed, the latter feature overcoming the objection to the dynamo type of igniter.

There have been of late great advances made in this size of gas and gasoline engines, while the best practice seems to incline toward the multiple cylinder. These engines, by reason of the nature and volume of the body of gas to be ignited, the high frequency of the spark and also on account of peculiarities in the construction of the make-and-break device, require a large and practically continuous flow of current to produce satisfactory ignition.

It is well known that the strength of magnetization obtainable in the best permanent magnets is for a given weight, relatively quite

GAS ENGINE IGNITER.

small in comparison with that which may be secured with an electro-magnet. It is evident, then, that a machine of the permanent magnet type constructed to deliver any considerable amount of energy would be unnecessarily large and heavy. This igniter has been, therefore, made of the dynamo type for the reasons given. It weighs 19 pounds, and will, if necessary, deliver continuously a maximum output of 50 watts.

As stated, the dynamo is practically independent of speed and at 1,000 r. p. m. will deliver ample current for satisfactory ignition, while the speed may be increased to 2,500 r. p. m. without any danger from burning out. Thus the igniter may be driven from the fly wheel of the engine with the ordinary belt or friction pulley.

The field core is of a solid casting of soft steel, and the armature is of the drum type carefully laminated and wound with double silk-covered magnet wire. The shaft is of high-grade steel, and the bearing sleeves are of phosphor bronze. The brush holders and commutator are large and heavy, while the brushes are of a special composite structure, combining the substantial qualities of carbon with the higher conductivity of the copper.

The machine is rendered quite impervious to dust and moisture by a protecting shield, which fits over the commutator and brushes. This may be easily removed, making the brushes and commutator readily accessible. The body of the machine is mounted on a light hinged base in such a manner that a wide range of adjustment may be effected without using sliding contacts or clamping nuts.

New Type of Controller.

The Electric Controller & Supply Company, Cleveland, Ohio, has added to its line of manufactures a new design of controller, the arrangement and construction of which particularly adapt it to the control of standard cranes and other electrically-driven machinery which is not subjected to excessive overload.

Fig. 1 shows a front view of the controller, and Fig. 2 is a rear view of the slate face showing the resistance units and connections.

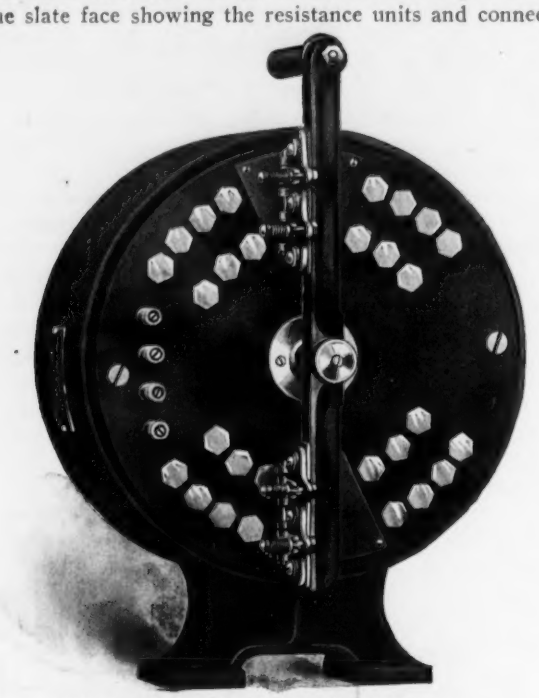


FIG. 1.—FRONT VIEW OF CONTROLLER.

It will be noted that all of the working parts of the controller are carried by the slate face. The frame, which consists of a single casting, serves simply as a protection and support for the working parts. The removal of two screws frees the face from the frame and permits ready inspection of all the controller connections.

Fig. 3 shows in detail the construction of one of the resistance units. The core of the unit is a rod of soft iron over which is placed a heavy tube of asbestos. Caps are provided at either end of the

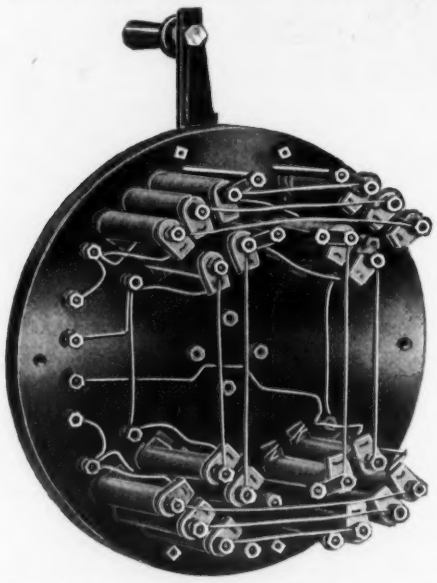


FIG. 2.—REAR VIEW OF SLATE FACE.

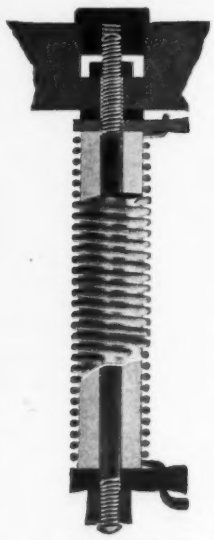


FIG. 3.—A RESISTANCE UNIT.

tube for receiving the ends of the resistance winding, the cap at the rear end of the tube being of insulating material and that at the forward end being of copper threaded on to the iron core. The core is extended beyond the copper cap and passes through the slate face, where it is locked in position by a lock nut working in a counterbored recess. The contact button, which is drop-forged from pure lake copper, has an octagonal head which is grasped with a wrench and screwed in place on the end of the core. It will be readily seen that by this construction the contact button can be removed and replaced without in any way disturbing the resistance unit or its connections. Furthermore, the iron core of the unit performs three functions: First, it carries the forward end of the resistance winding to the rear end of the unit, thus bringing all connections to the various units into one plane; second, it connects the resistance winding to the contact button; and third, it forms the core of a powerful electromagnet of which the turns of resistance material form the exciting winding. By this construction each contact is placed in a powerful magnetic field of its own and an efficient blow-out provided.

A further unique feature in the construction of the controllers is illustrated in Fig. 4. The frame is finished with four bosses set 90 degrees apart. By altering the position of the two screws which hold the face in the frame, the controller may be adapted to a variety of methods of support maintaining the operating lever in a vertical position. To give further flexibility the handle is adapted to be attached to the operating lever in three positions, at right angles to it, on either side, or screwed directly into the end of the lever. The

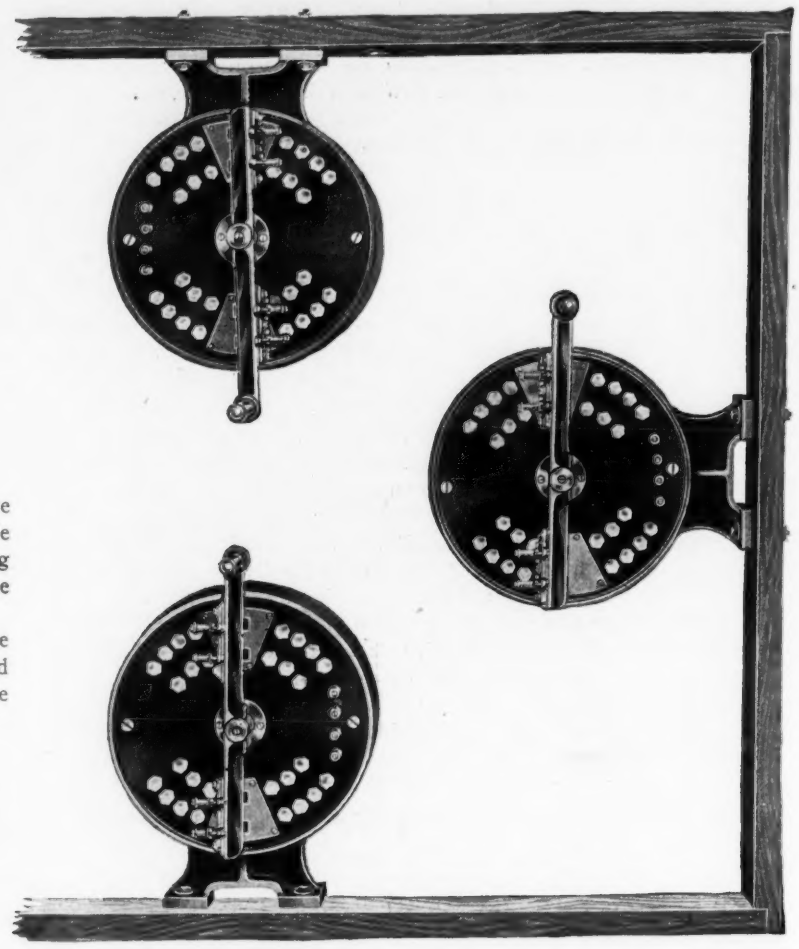


FIG. 4.—THREE DIFFERENT POSITIONS OF CONTROLLER.

controller is also adapted to overhead support and to be operatd from the floor by means of chains or ropes. A powerful spring is provided which returns the arm to the off position when the ropes are released.

"Standard" Bipolar and Multipolar Machines.

A company for the manufacture of dynamos and motors has recently been organized at Erie, Pa., under the style of the Standard Electric Company, by Mr. Carson J. Sturgeon and others. It is now producing various apparatus and we illustrate two types.

The form showing two poles is made either with two or four poles, and of 1½, 3, 5, 7½, 10, 15, 20, 25 and 30 horse power, C. P. direct current motors and generators, 125, 250 and 500 volts. The armatures are of the iron-clad type, with coils wound in slots. All two-pole machines have Gramme windings, and the multipolar machines are wound with formed coils, or barrel winding type.

The type of machine shown with four poles is made in the following sizes: 12, 23, 33 and 40 kilowatt, slow-speed generators (belt driven), and 15, 30, 40 and 50 horse power, slow-speed motors. The company also make in this type, medium-speed, belt driven gene-

rators of 16, 30, 45, 50 and 70 kilowatt, and medium-speed motors of 20, 36, 57 and 63 horse power.

All these machines are wire-wound, with formed coils, and only the best grade of insulation is used. The commutators are all made of

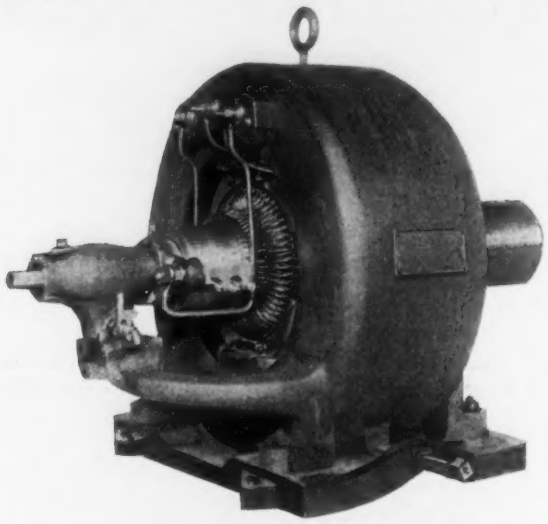


FIG. 1.—BIPOLAR MACHINE.

drop-forged copper with hand-made mica insulation, and the construction is such that the bars cannot get out of place. By means of powerful compression jigs, the commutators are pressed firmly into place, and are finished and firmly set before removing the jig. The

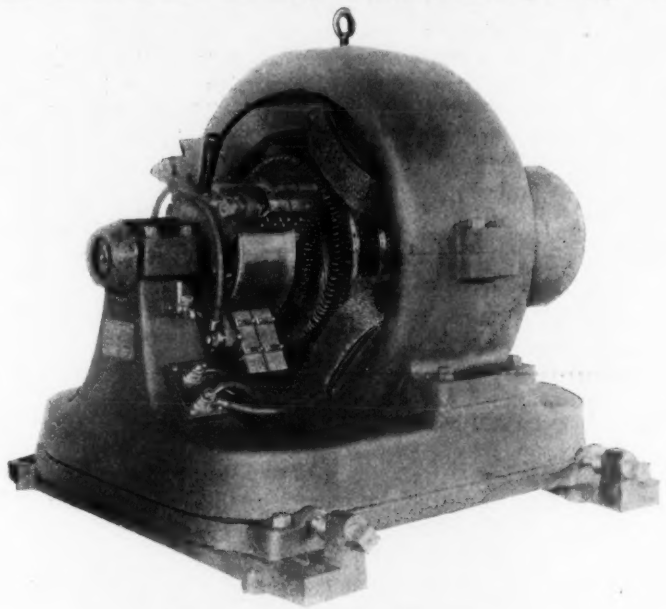


FIG. 2.—MULTIPOLAR MACHINE.

bearings are all made self-oiling and self-aligning, and are so constructed that no oil will be thrown from them on any other part of the machine. The field yoke of these machines is of cast iron with laminated poles and a cast iron pole shoe surrounding the pole face.

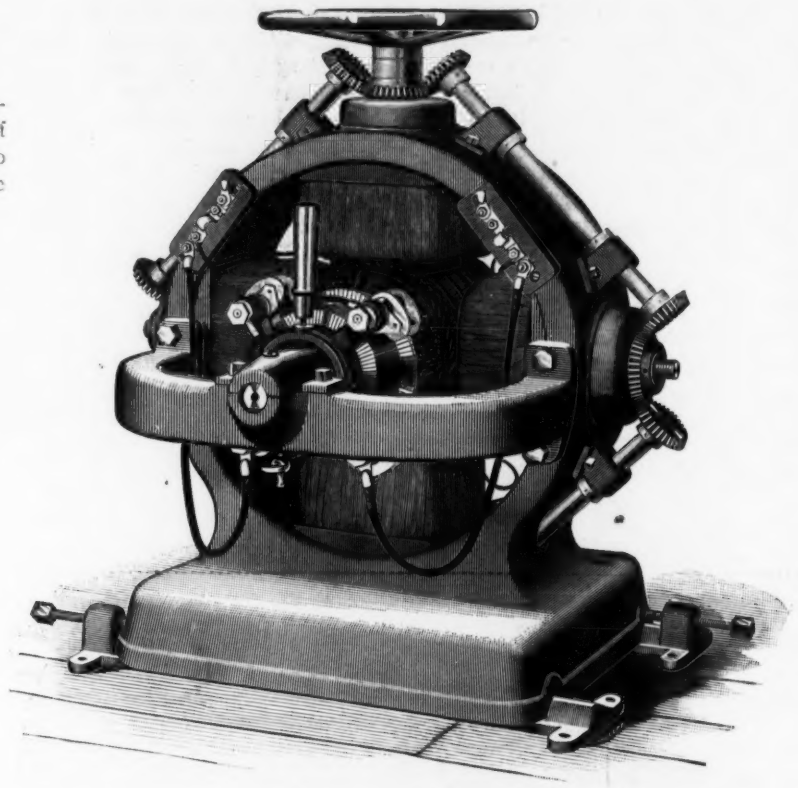
Multi-Speed Motor.

The latest type of the Stow 4-pole, "Multi-Speed" motor is illustrated herewith. This motor has been designed to combine all the advantages of the ordinary multipolar motor with the added advantage of an operative speed range of 100 to 150 per cent from minimum speed, the percentage of speed variation increasing with the size of the machine. The armature rotates in a balanced magnetic field under all conditions of speed, this magnetic balance being secured by a simultaneous radial adjustment of the four "plungers" by means of bevel gearing, a hand wheel, by which the plungers are moved, being located conveniently at the top of the machine.

The design of the pole pieces and the selection of gearing is such that no great effort is required at the hand wheel in order to move the plungers against the tractive power of the field magnets. As the gears are small, and the gear rods lie close to the frame of the motor, it will be seen that this mechanism does not detract from the otherwise symmetrical and pleasing design of the machine. While the cut shows an open type machine, the design is such that if an enclosed motor is desired the armature supporting brackets are removed and the ends of the frame finished so as to receive suitable enclosing heads, in the center of which the armature bearings are arranged.

The 6-hp machine, shown in the cut, is designed for a minimum speed of 700 r. p. m., the maximum speed being 1500 r. p. m., giving a total speed variation of 115 per cent, at any speed between which limits the machine develops its full rated horse-power with an efficiency of but 2 per cent less at its maximum than at its minimum speed. In other words, within the limits of 115 per cent variation, the efficiency of the motor at a given load is practically independent of the speed at which it is operated.

The construction of the pole piece and plunger is similar to that used in the bipolar form, the field strength, consequently the armature speed, being varied in accordance with the position occupied by the pole-piece-cores or "plungers." When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of minimum reluctance; and, since the



6-HP. MULTI-SPEED MOTOR.

m. m. f. of the field coil remains constant, the magnetic flux becomes a maximum and the speed a minimum, or normal. As the plunger is being drawn away from contact with the pole shoe an air space is interposed which gradually increases the reluctance of the magnetic circuit so long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion, the reluctance of the magnetic circuit, and hence the speed, becomes a maximum.

To those familiar with motors of ordinary type, a variation in speed of 115 per cent by a corresponding variation of magnetic flux would seem impossible of realization on account of the difficulty of securing sparkless commutation when the field strength of the motor is so abnormally reduced. In the present type, however, the design of the pole piece and plunger is such that as the flux of effective magnetism is diminished by the outward movement of the plunger, the remaining magnetic flux is forced more and more in the direction of the pole-tips, thus furnishing a magnetic fringe at all times of sufficient intensity to insure sparkless commutation.

As the speed regulation is effected solely by varying the reluctance of the magnetic circuits, no controller or rheostat is, of course, used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed. The machine illustrated represents a type which is built in sizes of

5-hp up to 25-hp. For sizes above 25-hp automatic means can be furnished for varying the speed.

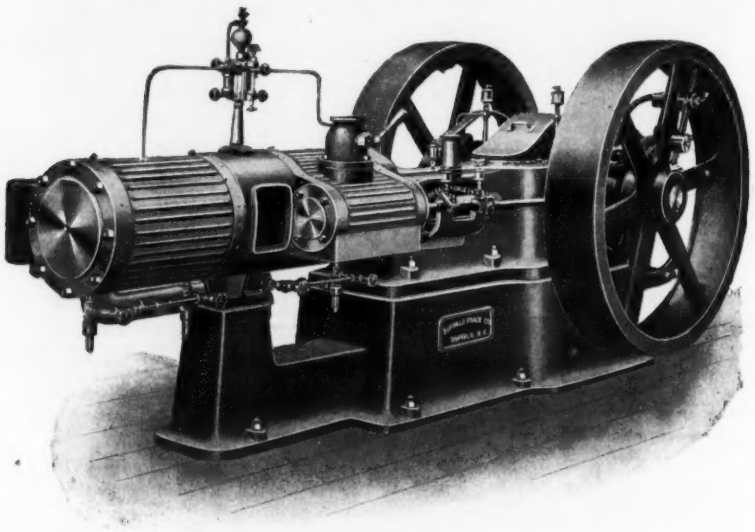
Owing to the design, the special advantages offered by these motors are obtained, it will have been seen, without the sacrifice of any advantageous feature possessed by machines of the ordinary type, the efficiency in every case being fully up to the standard of first-class modern practice. Moreover, the self-regulation of the machine is as close as, and in some cases closer, than the regulation of motors of common form, this being due to the ample size of the armature conductors used in these machines. They also carry full load sparklessly at any speed within their range, commutation being accomplished as well at the highest speed as at the lowest.

It is interesting to note that while in the case of other motors, the number of operative speeds corresponds to the number of steps in the controlling device, the motor herewith described possesses a speed range of absolute continuity; in other words, between the maximum and minimum limits an infinite number of speeds may be obtained, without the use of any controller or rheostat.

Buffalo Tandem Compound Engine.

The cut herewith gives a general idea of the horizontal tandem compound engine manufactured in the engine department of the Buffalo Forge Company's works, and used largely by that concern for dynamo driving. A heavy cast-iron sub-base furnishes a solid support to which to bolt the engine bed, and at the same time raises the engine sufficiently for the fly-wheels to clear the floor or foundations. In the case of dynamo direct connection, this sub-base may also provide a bed for the generator, and in addition carry the outboard bearing. The high pressure cylinder is placed in front, bolted at one end to the head cast to the frame. The other end is bolted to a yoke or connection between the cylinders, which also carries the overhung low pressure cylinder. The foot of this yoke rests upon a pedestal extension of the sub-base with a feather or expansion joint connecting the two. The three movable cylinder heads are so fastened to their respective cylinders as to make feasible their easy detachment with the pistons and rod, if occasion requires. This, with the ready accessibility of all stuffing boxes, is a distinct feature of the Buffalo tandem compound engine. The pistons are single castings cored thin, giving maximum strength with minimum weight, and causing but little wear on the bottom of the cylinders.

The crank shaft and connecting rod are of forged steel, the latter of which is fastened to the crank-pin by means of a strap and wedge.



TANDEM COMPOUND ENGINE.

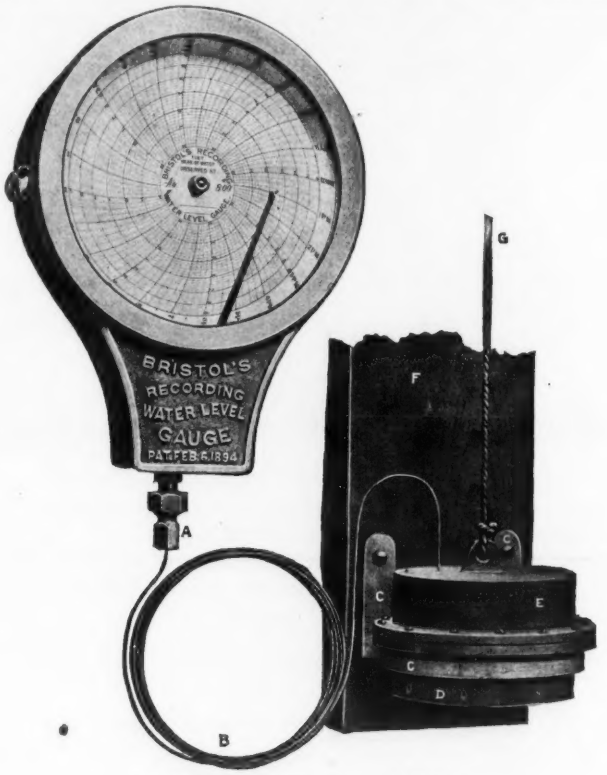
The wedge is completely enclosed by the strap and box and is securely held by two adjusting lock bolts. The high pressure valve is of the piston type, while the low-pressure end is fitted with a balanced D slide valve with a pressure plate. The former valve is under the control of shaft governor, while the low-pressure valve may also be driven by the swinging eccentric, or, according to an alternative construction, by a fixed eccentric, so arranged as to permit alteration of the cut-off at all times. This arrangement is effected by means of bolting the eccentric sheave in such a manner as to permit change of throw and angular advance, and hence cut-off at pleasure. The fly-wheel governor for the high-pressure side is of the most sensitive type. It is provided with three means of adjustment, so that it may be accurately set to control the engine at any given speed; in addition, grease or oil cups are provided on every pin. Indeed, one of the most prominent features of the engine is its thorough system of lubrication.

This engine is enclosed to run in oil, and a positive means of lubrication is thereby furnished for the main bearings crank-pin, wrist-pin and crosshead slides. An ample supply of oil for the wrist-pin is insured by a cup on the pin, which is filled continuously with oil thrown back from the crank disks, and communicates with the rubbing surfaces. Pockets or receptacles located within the bed near the crank disks are kept filled with oil while the engine is in motion, and feed the necessary amount of lubricant to the main bearings. Provision is made for returning the oil to the crank-pit after it has been supplied to the various rubbing surfaces. A light polished hood and two side plates give a perfectly oil-tight construction, and being easily removable, afford ready accessibility to the various moving parts. A large sight-feed lubricator takes care of the cylinders and valve chests. The very best babbitt metal is used throughout this engine at all bearing surfaces, and adequate means are provided for adjustment and taking up of wear.

Recording Water Level Gauge.

The Bristol Company, of Waterbury, Conn., are placing upon the market an adaptation of their recording pressure gauge to an instrument for making a continuous record in ink upon a revolving chart, of the rise or fall of the level of water in a canal, reservoir, well, tank, or variations of sea level.

The construction and operation of the instrument will be readily understood by reference to the illustration shown herewith. *A* represents the union joint by which a flexible capillary tube *B* is connected to the recorder. This connecting tube terminates in the



RECORDING WATER LEVEL GAUGE.

upper portion of the bulb casting *E*, and when the instrument is in operation it is immersed to the depth a record is desired. Between the flanges of the upper and lower parts of the bulb, *E* and *D*, a flexible diaphragm (convex downwards) of thin sheet rubber is firmly held, inclosing the proper amount of air for the operation of the instrument. Near the bottom of the lower casting *D* there are several holes for admitting water, the pressure of which acts upon the lower surface of the diaphragm, producing on the inclosed air a corresponding pressure due to its depth below the surface. The variations of the air pressure thus produced are communicated

by means of the capillary tube to the recorder. The chart on the recorder is graduated into feet or inches head of water, or of the liquid which is being measured, and it may be adapted to almost any desired range.

The upper casting of the air-bulb is provided with an eye for a cable suspension. The air bulb is also shown with a flange resting on a ring bracket *C*. This bracket is designed to be secured to a plank *F*, which may be lowered into the water to any desired depth.

The recorder may be located at any convenient point for observation, either above or below the surface of the liquid to be recorded. The accuracy of the instrument is not affected by the location of the recorder or by the length of the capillary connecting tube. An important advantage that instruments of this form have over those of ordinary type which are operated by floats, is that its continuous performance and accuracy cannot be affected by ice in winter.

Telephone Pay Stations.

CONSECUTIVE COUNTER.

The American Toll Telephone Company, of Cleveland, well-known through the manufacture of telephone pay stations, has just added several new device of this description to its line. One of the new machines makes impossible the common and sometimes fradulent practice of depositing two or more coins at the same time. For instance, if the rate should happen to be 40 cents, the subscriber by dropping a nickel and a dime into the pay station, can produce a jumble of signals, making it impossible for the operator to determine as to the amount deposited. The subscriber can, therefore, make the claim that he deposited 40 cents, and the operator cannot dispute him, as she is aware that more than one coin has been deposited. With the new machine, when the subscriber has deposited one coin, it is impossible to deposit another until the first signal has been given, the second coin simply slipping through the machine and dropping into the pocket shown in the side of the station. The difficulty described is one which has always deeply concerned telephone exchange managers, and has been an objection to the use of pay stations.

Another useful device recently brought out by this company is the "consecutive counter," herewith illustrated. It is used in the exchange for the purpose of taking the peg count, or it may be used for counting poles, insulators, or keeping correct tallies of any kind. It is a very simple and convenient device, with nothing to get out of order.

Chicago Independent Telephone Convention Notes.

A report of the convention proceedings appears on pages 686-688. Subjoined are notes of the exhibits, etc.

KELLOGG.—Automobiles were kept in waiting at the Sherman House to take those who wished to visit the factory of the Kellogg Switchboard and Supply Company to that company's plant on the west side, at Green and Congress streets. The company had a small exhibit of telephone parts and switchboard parts in the hotel. It, however, made no pretension to cover its line of goods manufactured in this way, but invited all interested to see its "real exhibit" at the factory. This exhibit consisted not only of a 3,000-line board, equipped for 80 lines and doing actual service in the factory as a means of intervention between different departments, but consisted also of the complete process of manufacturing telephones and switchboards as carried on in its factory. A great many availed themselves of the opportunity of visiting this most extensive and growing plant, and every visitor was impressed with the thoroughness with which every detail is looked after in the process of manufacture. Every department of the Kellogg factory is in charge of a man known as an expert in that particular line of work, and the company is particularly noted for the high-grade of engineering talent it employs. Among the new things which were being shown at the parlor exhibit was a row of jacks such as are being made to go in an 18,000-line, multiple-jack switchboard for Buffalo. These jacks are the smallest yet made for a large multiple board, being three tenth-inch between centers. By using such small jacks, the 18,000 subscribers' lines can be brought within a reach of 35 inches for each operator, which is somewhat less than some boards which are being worked at present. In addition to the 18,000 calling jacks, there are at each operator's position 200 answering jacks on the Buffalo board, which is somewhat more than the usual number, so that taken altogether, this board will contain much more at each position than anything heretofore used. Plugs and answering jacks as small as these can be successfully made, because in the Kellogg system there are only two tip contacts to be made by plugs. The plug when shoved home has a side tension brought upon it by the spring of the jack, which insures good contact with the sleeve. Over the door of the company's parlor was a sign, made of miniature lamps, the interest of which was heightened by the fact that the lamps are a new product of the Kellogg factory, and are soon to be put on the market. This company claims the honor of being the first independent telephone concern in the field to begin the manufacture of its own incandescent lamps for switchboard signaling. These lamps are tipless, and have sliding contacts on the bulb. A corps of twelve efficient engineers and salesmen looked after the Kellogg interests at the convention.

"READY" put-out reels of single and double deck types, made by the W. G. Nagel Electric Company, of Toledo, Ohio, were found on the floor of parlor 309, exhibited by Harry E. Adams, manager of the sales department of this company. These reels are made to receive readily an ordinary spool or reel and allow it to revolve on a horizontal axis with whatever friction tension-adjustment seems necessary. Nagel pole-houses and line-tools as well as miscellaneous telephone supplies are also handled by this company.

THE FARR TELEPHONE CONS. & SUPPLY CO., which does a large business in toll lines and farmer line apparatus, occupied the walls of parlor 318 with different types of instruments. The most prominent feature of this exhibit was the powerful magneto-ringer, which was connected to no less than 35 telephones bridged across the line, and ringing them all strongly. This company is now selling a great many magneto instruments, built somewhat on the external lines of central-energy telephones, with all the apparatus in a single box, on the front of which the receiver and ringing bracket are placed.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY had a good line of apparatus on display, including some small switchboards. The company has been long known in the independent field. The factory is now located at Winthrop, Ill., although its main offices and salesrooms are in the Fisher Building, Chicago. This company's exhibit consisted of well-known and standard apparatus, which now requires but little description.

THE SWEDISH-AMERICAN TELEPHONE COMPANY had a novelty on exhibit in the shape of a new magneto-telephone generator, with coils completely enclosed in a revolving cylindrical part, which offers no opportunity for the collection of dust or dirt to interfere with the working. As usual, this company was calling attention to the very strong points of its transmitters and receivers. Plenty of different styles of telephone instruments were shown, and salesmen from the different sections of the country were on hand to look after customers from their respective territories. The Swedish-American have always been noted for the good quality of workmanship bestowed upon them, and the large crowd always to be found at this company's exhibit-room showed the popularity of the company and its apparatus. The menu prepared by this company for the banquet was one of the cleverest pieces of literature at the convention.

THE AMERICAN ELECTRIC FUSE COMPANY had a menagerie in full operation during most of the convention, which served to attract visitors who afterwards stayed to learn more about "Protective devices that protect." The protectors and fuses exhibited did not take much space, but made up in interest what they lacked in bulk. The heat plugs, made by this company, are very compact and neat. Any excessive current heats a tiny graphite rod, which conducts enough heat to surrounding parts to cause some fusible metal to let go. Heat coils in place of plugs are furnished those who desire. Double-sleeve twist-connectors, for both iron and copper wire, are another specialty of this company.

AMERICAN TOLL TELEPHONE COMPANY.—The question of pre-payment and measured service devices is daily becoming more important with all telephone companies. The American Toll Telephone Company, of Cleveland, maker of "pay stations that pay," had a very complete line of devices for pre-payment and measured service, all of which presented combinations hard to beat, and having features

by which a large percentage of the "slugging" and other schemes used to circumvent "nickel-in-the-slot" machines are being overcome. This company has confined itself mainly to mechanical signals, placed on the subscribers' instruments, which indicate to the central office operator by sound conveyed to the transmitter alone. These instruments are far ahead, however, in the character of the signal they give, which is in all cases very hard to counterfeit, with combs rubbed across the transmitter or the many other common and easily-worked methods of beating the telephone slot machine.

CHICAGO PAY STATION COMPANY.—A new "give back" nickel pay station apparatus, shown by the Chicago Pay Station Company, was one in which this company took much pride. In this slot machine the nickel or other coin must be deposited before the attention of the operator can be obtained. The presence of the nickel in the machine is made known by the operator the instant she plugs in to answer the call, by a sound due to an electrical connection in the slot machine. If the operator is able to get the connection desired the nickel remains in the machine. If she cannot get the connection desired, she throws a releasing current into the subscribers' line, which will allow the nickel to be released by pulling a knob on the slot machine. Another improvement recently introduced in this company's line of machines, is that in case of a pay station where coins of several sizes are provided for the several gong signals. The signals for the three different coins are separate and operated by three different push-buttons, so that if all three coins should be deposited at once, it would be impossible for the calling subscriber to ring the three at once.

MAGNETO AND DYNAMO-RINGING GENERATORS, together with small direct-current and alternating-current motors for driving them, and storage battery charging sets formed part of the interesting exhibit of the Holtzer-Cabot Electric Company. This company's small motors have always been noted for the excellence of their design and workmanship, and the exhibit amply bore out this reputation. A number of these motor-generators sets were shown in operation. The different types of telephone instruments this company makes were also shown, among which should be especially noted the automatic fly-back switch, whereby the switch on an intercommunicating instrument is automatically thrown back to zero when the receiver is hung up after a conversation.

THE STROMBERG-CARLSON TELEPHONE MFG. CO. occupied the most prominent place among the large independent manufacturers at the convention headquarters hotel, having a reception room next to the registration and committee room. Here some of the company's staff were always on hand to receive delegates, and light refreshments were served. For all delegates who wished to visit the company's immense factory at Clinton street and West Jackson Boulevard, carriages were in waiting. Even the best-posted telephone exchange operators could not help expressing surprise at the enormous growth of this company's business within the past few years into the present immense factory, which is even now filled to overflowing, although occupied in full but a short time. The company made no exhibit of apparatus at the hotel, preferring to take visitors to its factory, where both the full lines, apparatus and methods of manufacturing could be shown. Mr. J. J. Nate, of the Stromberg-Carlson Telephone Mfg. Co., was a member of the committee responsible for the convention, and took a most prominent part in all the preparations.

AMERICAN ELECTRIC TELEPHONE COMPANY.—Representatives of the American Electric Telephone Company were found everywhere about the hotel headquarters prepared to accompany visitors to the American Electric Telephone Company's factory at Canal and Jackson streets. This factory is now one of the largest manufacturing concerns in the great west side machinery district of Chicago, and the equipment of this factory for turning out any quantity of work, for which it is noted, is a matter of general interest. At the office and factory special preparations were made to receive visitors and show them over the works.

TELEPHONE BURGLAR AND FIRE ALARM COMPANY.—A combination telephone and burglar alarm system was shown for the first time at this convention. This is a scheme originating in Rochester, N. Y., which is the home of the new Telephone and Fire Alarm Company. Its purpose is to make the ordinary subscribers' telephone circuit serve the double purpose of a telephone and burglar alarm circuit. The idea is to prevent burglary by automatically notifying the central office in case such a thing is attempted. This is accomplished by a simple buzzer device, which is connected up to contacts at the doors and windows at the house to be protected with the burglar alarm circuit. Any attempt to open doors or windows in the protected house will close the buzzer-circuit, which, by means of an induction coil, will send sufficient pulsating current over the line to drop the subscribers' calling signal at the central office switchboard. The operator then plugs in to respond, just as in the case of an ordinary call. The buzzer still being in circuit, the operator upon plugging in receives a loud buzz in the ear, notifying her of the attempted burglary at the subscribers' house. This device is being used in Rochester, and on account of the protection offered to telephone subscribers at a small price, may prove popular.

ELECTRIC APPLIANCE COMPANY.—A number of telephone devices as well as interior telephones of "Eaco" brand were shown by the Electric Appliance Company of Chicago. Indeed, the extent in which this company has entered the telephone manufacturing business proved a surprise to those familiar with its large general supply business who have not kept closely in touch with its telephone department. Among the specialties exhibited may be mentioned the Eaco visual signal metallic-circuit switchboard, the country or party-line switchboards for metallic or grounded circuits, the Eaco plug-switch, for use in connecting grounded country or party-lines or extension bells, and the Griggs adjustable swinging telephone brackets for attachments to desks where a desk telephone is used.

THE NEW PUSH-BUTTON TELEPHONE, made by the American Push-Button Telephone Company of New York, was a neat novelty which attracted much attention. This is a transmitter and receiver combination, for interior telephony, which, when the receiver is hung in its place in front of the transmitter, has the appearance of a large push-button. In fact, the push-button for signaling is located in the back of the receiver. It makes a very neat combination.

THE CHICAGO TELEPHONE SUPPLY COMPANY advertised itself extensively around the hotel, and also exhibited a full line of its telephones in one of the parlors. This company is known as the great mail-order factory, and caters especially to farmers and country toll-line business. Telephones especially adapted to this purpose were shown, and also toll boards and switchboards for small exchanges. A phonograph saved the salesman in attendance the expenditure of much lung energy by continuously expounding the merits of the goods. An unusally strong generator for toll and farmer line ringing was shown. "Crops, Comfort and Telephones" was the suggestive title of a booklet distributed, dealing especially with the advantages and construction of farmers' telephone lines.

STERLING ELECTRIC COMPANY.—"Bell style" telephone apparatus was exhibited in one of the parlors by the Sterling Electric Company of Lafayette, Ind. It is well known that this company has always made a specialty of protective devices, cable terminals of various kinds, and distributing boards. The section of multiple board, with a capacity of 4,000 lines equipped for 2,000 lines, was the most prominent feature in the exhibit. The jacks on this board were spaced ½-inch between centers. This section of board was from that being built for the Rockford, Ill., exchange. The Toledo multiple board, equipped by this company for 6,000 lines has jacks 3/8-inch between centers. On these boards the condensers are placed in rows on a shelf at the top of the back of the boards, where they are out of the way, and at the same time easily accessible.

THE WARNER POLE CHANGER, for taking the place of a constantly-driven generator for central office telephone ringing, was shown in the parlor of the Electric Appliance Company. P. W. Warner, of the Warner Electric Company, of Muncie, Ind., which manufactures this device, was in attendance. The Warner generator is now too well known among telephone exchange men to justify any extensive description here. The generator shown was adapted for selective ringing on party lines, and could be arranged to give either positive or negative pulsating current as well as alternating current.

THE EUREKA ELECTRIC COMPANY, of Chicago, which occupied one of the parlors, made strong claims for its Bell type transmitters. It displayed a great many detailed points, both assembled and apart, as well as its instruments and switchboards. The company makes everything from the central-energy switchboard to the simplest toll-line board, as well as telephones for special service.

THE HIPWELL TELEPHONE was exhibited in various forms at the Sherman House by the Hipwell Mfg. Company, of Allegheny, Pa.

THE VARNEY ELECTRICAL SUPPLY COMPANY, of Indianoplis, had headquarters at the Sherman House.

MR. J. R. WILEY, western manager of the Standard Underground Cable Company, as usual at conventions, made a parlor display of samples, assisted by W. A. Caldwell, superintendent of construction, and W. M. Rogers.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was obtainable with comparative freedom, the closing rates being 4¼@4¾ per cent. for thirty days to six months. In the stock market there was decided activity, standard stocks, railroad specialties and some industrials recording advances. United States steel stocks were steady and well supported; Amalgamated Copper showed strength early in the week, on talk of a settlement with the other copper-producing interests in the Montana litigation. General Electric was very strong on the announcement that the stock is to be increased and a stock-dividend of 50 per cent. or more declared. It closed at 331, a net gain of 5⅛ points, having reached 334 during the week, the lowest figure being 323. The sales of this stock, however, aggregated only 7,400 shares. Westinghouse was another feature, advancing from 195 to 230½, and closing at 226, a net gain of 28½ points. Westinghouse 1st preferred exhibited like activity, and jumped from 201, the lowest figure, to 234, closing at 226½—a net gain of 25½ points. In the traction list weakness prevailed, Brooklyn Rapid Transit closing at 65, being a net loss of ¾ point. Metropolitan Street Railway lost 1½ points net on transactions of 22,500 shares, the closing price being 152½. Western Union is unchanged, at 90½, the price having kept very steady at about this figure all through the week. American District Telegraph closed at 33½, a net gain of ½ point; American Telegraph and Cable, 88, a net gain of 2½ points, and American Telephone and Telegraph, 184, a net loss of 1. In Boston, American Telephone and Telegraph advanced ¼ point, and General Electric was quiet, but closed with a net gain of 7 points. Following are the closing prices of April 15:

NEW YORK.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Tel. & Cable..	87½	88¼	General Electric.....	325½	329
American Tel. & Tel....	183	180	General Carriage.....	⅞	¾
American Dist. Tel.....	33	—	Hudson River Tel.....	—	—
Brooklyn Rapid Transit..	65⅝	65	Metropolitan Street Ry..	165	153
Commercial Cable.....	150	152	N. E. Elec. Veh. Trans..	1	1
Electric Boat.....	26¾	26½	N. Y. Elec. Veh. Trans..	12⅜	12
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅜	1⅜	Tel. & Tel. Co. America..	4½	4½
Electric Vehicle.....	3	3¼	Western Union Tel.....	90	90½
Electric Vehicle pfd.....	6⅞	7¼	West. E. & M. Co.....	214	—
			West. E. & M. Co. pfd..	215	—

BOSTON.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Tel. & Tel...	*183½	180	Mexican Telephone.....	2¾	2½
Cumberland Telephone ..	—	125	New England Teleph....	147	149⅜
Edison Elec. Illum.....	—	272	Westinghouse Elec.....	—	111½
Erie Telephone.....	—	—	Westinghouse Elec pfd..	—	112½
General Electric pfd....	—	329⅝			

PHILADELPHIA.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Railways.....	—	44¼	Phila. Traction	97⅞	98
Electric Storage Battery.	74½	77½	Philadelphia Electric....	5½	5¼
Elec. Storage Batt'y pfd.	74½	77½	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅝	7⅞	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
Central Union Telephone.	—	—	National Carbon pfd....	90	*89
Chicago Edison.....	—	175	Northwest Elev. com....	37	—
Chicago City Ry.....	220	*220	Union Traction.....	19⅜	20⅞
Chicago Telep. Co.....	*180	—	Union Traction pfd.....	—	—
National Carbon.....	24	20¾			

*Asked.

GENERAL ELECTRIC STOCK.—It is figured out that the proposition to increase the capital stock of the General Electric Company to $45,000,000 contemplates making the capital practically the same as it was at the start when there were $10,000,000 (authorized) of 5 per cent. debentures, $4,000,000 preferred stock, and $30,000,000 common, or a total of $44,000,000. In 1898 the then outstanding stock, $34,712,000 was reduced 40 per cent., to $18,276,000 common and $2,551,000 preferred. In 1900 the company increased the common stock by $4,415,000 to redeem the then outstanding $5,298,000 debentures, which have been largely converted. The preferred stock has been mostly exchanged for common stock, share for share. The company's stock now stands at $25,242,200, and is practically all common stock. Of the new issue, which stockholders will authorize on May 5, all but about $3,000,000 will be presented to stockholders in restoration of the 40 per cent. cut made in 1898. The holders of the present outstanding $25,242,200 stock will therefore receive a benefit to the extent of 66 2-3 per cent. of their present holdings. This will absorb $16,761,000 of the new stock issue, leaving about $3,000,000 for the treasury. The company's profit and loss surplus on Jan. 1, 1902, was $13,000,000, and by June 1 it is expected to be between $16,000,000 and $17,000,000. This will enable the distribution of the above $16,761,000 stock, which distribution, however, will not take place prior to June 1.

INTERSTATE INDEPENDENT TELEPHONE AND TELEGRAPH COMPANY.—Just previous to the convention of independent telephone men from Illinois and six surrounding states, came the filing of a trust deed, at Joliet, Ill., covering $50,000,000 in bonds of the Interstate Independent Telephone and Telegraph Company. This gave rise to some speculation on the part of the daily press as to whether there was a connection between the convention and the company, and one paper even went so far as to announce that the convention was for the purpose of forming a $50,000,000 telephone combination. Nothing of the kind was contemplated as an immediate result by the promoters of the meeting, however. The Interstate Telephone and Telegraph Company was formed some time ago, to acquire control of various telephone companies. At present it only has control of the Joliet and Elgin (Ill.) independent exchanges and surrounding toll-lines, built by the Northwestern Telephone Company. Bonds, to the amount of $500,000 only will be issued, to purchase this property. The officers of the new company are: President, Harry E. Evans, Aurora, Ill.; vice-president, Frank W. Tracy, Springfield, Ill.; treasurer, Archie B. Conklin, Aurora, Ill.; secretary and general manager, E. R. Conklin, Aurora, Ill.; general counsel, Mazinni Slusser, Chicago.

ELECTRIC COMPANY OF AMERICA.—The announcement is favorably regarded that enough stock had informally assented to carry a proposition at the Electric Company of America annual meeting to make the stock full paid $10, and a net assessment of about $1 per share. The assessment will bring about $400,000 new money into the treasury, and with what is already there will give the company about $700,000 cash funds in hand. The way in which the arrangement came about is understood to be this. The proposition was taken up by certain stockholders, and a following sufficiently large was obtained to secure the co-operation of the management and to secure an arrangement to have the proposition voted on by the stockholders at the meeting. That enough stock is now in favor, to put through the plan, is admitted. The board of directors has hitherto been divided on the question for removing the assessment liability, and E. C. A. is one of the last of the comparatively new stocks to go out of the Philadelphia assessable list, but it has come to be pretty generally recognized, even on that market, that most stocks sell to better advantage now-a-days when they are full paid than when they have the assessable feature.

PHILADELPHIA ELECTRIC REPORT.—The annual report of the Philadelphia Electric for the year ended Dec. 31 shows: Gross income from all sources, $3,295,971; operating expenses, taxes and charges, $2,980,791; balance, added to surplus account, $315,179; surplus for 15 months, ending Dec. 31, 1900. $131,947; total present surplus, $446,677. Lamps connected Dec. 31, 1901: 16 candle-power, 675,995, increase over last period, 89,924; per cent., 15.34. The increase since organization is 35.35 per cent. The advances to subsidiary companies show: Overhead lines, $179,917; boilers, engines and steam apparatus, $218,351; dynamos, storage batteries and electric machinery, $188,039; underground construction, $127,808; real estate, $190,487; miscellaneous, $7,855; total, $912,460. The old board of directors were re-elected, with the exception of P. A. B. Widener, whom Mr. Chas. M. Swain succeeds. President Joseph B. McCall states in his report that the affairs of the company are in a shape to warrant the commencement of dividends on the stock of the company at an early date.

MASSENA POWER.—English investors have found an unprofitable scheme in the power plant at Massena, in northern New York. At this point a nominal capital of $10,500,000 has been expended in developing one of the largest power plants in the world in connection with the St. Lawrence river. The original capital was $6,000,000 of stock, then $3,000,000 of first and $1,500,000 of second mortgage bonds were issued, and nearly all the stock and bonds were sold in London. Practically all of this $10,500,000 has been expended in completing a 50,000-hp plant, but lack of customers for the power has led to the adoption of a reorganization plan, in which the bonds are to be exchanged for stock in a new company. The plant is all right, but full use has still to be found for its current.

ROCHESTER, N. Y.—Plans have been completed for the purchase of the Municipal Gas and Electric and the Citizens' Light and Power companies, both of Rochester, by the Rochester Gas and Electric Company. This will bring all the lighting interests under one control and management.

THE LONDON TRACTION DEAL.—With regard to the latest Yerkes traction financing in London, a special telegram, of April 11, from Baltimore, says: It was announced here to-day that the Baltimore interests, which financed the big London trolley deal, intend to withdraw from the Yerkes syndicate. The details of the plan under which the project is enlarged from a $5,000,000 to a $25,000,000 deal are objected to by these interests. The Maryland Trust Company, which is the fiscal agent for the original plan, is dissatisfied with the proposition now advanced for dividing prospective profits. It holds that this proposition is not in accordance with the agreement made by Charles T. Yerkes, of Chicago, who is directing the deal. Taking this view of the new plan, the trust company has decided to accept the alternative proposition which accompanies it. This is to receive back the cash invested, with 5 per cent. interest. It is likely that all the Baltimore capitalists who were interested also will withdraw their investment.

NEW YORK METROPOLITAN.—President Vreeland says the lease to the Interurban makes available $12,000,000 to $14,000,000 for improvements. At least $5,000,000 will be used this year. The first work will be the change in Ninth avenue, where eight miles of electric road will be built, four miles of double track, from Fifty-third street south to Cortandt Street Ferry. Then will come the change on the Eighth and Fourteenth street lines, and on the lower end of Second avenue.

HAVANA ELECTRIC RAILWAY.—The shareholders of Havana Electric Railway will vote on April 30 on propositions to increase the capital of the company from $11,000,000 to $12,500,000 by the issue of $1,500,000 common stock; also to make a consolidated mortgage securing $10,000,000 bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—According to reports received by the mercantile agencies, it is difficult to define the exact condition of the general commercial situation. Appearances, however, indicate that the check given to distributive trade by the reactionary weather, crop uncertainties and additional friction in industrial circles, is not of an abiding character. Bank clearings, all things considered, are of large volume, and the railroad earnings, as reported by Bradstreet's, point to continued increases over the same period a year ago; and special activity is noted in leading manufacturing lines, particularly iron and steel, lumber, coal mining, machinery making and a host of lesser industries. At industrial centers in the South, iron, coal and coke production is active, while the backward weather conditions are credited with limiting demand in agricultural sections. Iron and steel continued to lead in activity. Prices of Bessemer pig have advanced on the announcement of the closing of very large contracts, for delivery between October next and April next year, aggregating 225,000 tons. Foundry and forge iron are also firmer. Practically all the merchants' furnaces are booked with orders for the balance of the year, while in finished products no promises will be made for deliveries inside of three or four months. For finished products there is no diminution in activity in demand. The building trades also report undiminished activity, which, it is stated, has never before been so widespread. The railway gross earnings for the month of March were 6.7 per cent. more than the same figures for the like period last year. The granger lines and the Pacific Coast roads report a heavy percentage of increase—11.9 per cent. and 13 per cent., respectively. The Central Western and Middle States roads contribute a gain of 7.1, and the Southern lines show an increase of 5.8 per cent., while the trunk lines report an increase and earnings of 3.9 per cent. The business failures for the week, as reported by Bradstreet's, numbered 182, as against 176 the week previous, and 225 in the corresponding week last year. In the metal market, the situation in copper is extremely quiet. The demand is slow and prices show an easy tendency. Quotations are 12@12½c. for Lake, 12@12⅛c. for electrolytic, and 11¾c. for casting stock.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 29: Antwerp—8 pkgs. machinery, $278; 7 pkgs. material, $831. Argentine Republic—109 pkgs. material, $2,713; 5 pkgs. machinery, $420. Bristol—2 pkgs. machinery, $210. British Australasia—2 pkgs. machinery, $98. British East Indies—129 pkgs. material, $2,975. Bolivia—11 pkgs. material, $235. Bremen—16 pkgs. material, $366. British Guiana—17 pkgs. material, $349. Brazil—110 pkgs. machinery, $10,668; 1 pkg. material, $20. Berlin—1 pkg. material, $80. British West Indies—44 pkgs. material, $595. Cuba—1 pkg. machinery, $75; 49 pkgs. material, $1,177. Chili—15 pkgs. material, $1,106. Cardiff—16 pkgs. material, $405. Central America—1 pkg. material, $25. Dublin—7 pkgs. material, $200. Ecuador—6 pkgs. material, $24. Glasgow—4 pkgs. material, $150; 9 pkgs. machinery, $1,780; 4 pkgs. material, $150. Genoa—38 pkgs. machinery, $4,730. Hull—24 pkgs. machinery, $2,883. Hamburg—3 pkgs. machinery, $400; 22 pkgs. material, $779. London—22 pkgs. machinery, $2,530; 770 pkgs. material, $19,957. Liverpool—242 pkgs. machinery, $15,610; 28 pkgs. material, $1,055. Mexico—63 pkgs. material, $1,315; 6 pkgs. machinery, $56. Manchester—4 pkgs. material, $4,322; 290 pkgs. machinery, $25,433. Milan—1 pkg. material, $10. Naples—12 pkgs. machinery, $353; 7 pkgs. material, $50. Peru—3 pkgs. material, $202; 5 pkgs. machinery, $150. Rotterdam—4 pkgs. material, $27. Southampton—203 pkgs. machinery, $28,700. San Domingo—6 pkgs. material, $63. Savona—4 pkgs. machinery, $258. Zurich—1 pkg. material, $57.

McCLOUD RIVER POWER PLANT.—A special dispatch from Cincinnati states that the McCloud River Electrical Power Company, which is building one of the largest power plants in the West, on the McCloud river, has closed a contract with the Bullock Electrical Manufacturing Company, of Cincinnati, for all its electrical machinery. The Bullock Company has taken bonds of the Power Company for the entire cost of apparatus. Mr. H. C. Wybro, of San Francisco, has been engaged as electrical engineer, and A. J. Wiley, of Boise, Idaho, has entire charge of the hydraulic construction work. The McCloud River Electrical Power Company is capitalized at $1,500,000, and has issued $600,000 30-year, five per cent. gold bonds. The directors of the company are: Robert Gibson, New York; Henry B. Twombley, New York; Wm. R. A. Wilson, New York; George H. Proctor, New York; A. F. Johns, San Francisco; A. Hockheimer, Willows, Cal.; L. S. Barnes, Redding, Cal. The contracts already signed for power guarantee an income, it is alleged, of over $400,000 per annum.

DEVELOPMENT IN SPAIN.—The Commercial Museum, at Philadelphia, has received a communication from Madrid, Spain, calling attention to the formation there of a new electric company, with a capital of 6,000,000 pesetas, or about $960,000, which will utilize for illumination, motive power, traction, heating, etc., the hydraulic energy of a waterfall in the Jarama River, situated about eleven miles from Madrid. About three thousand horse-power will be developed for the work. Extensions are shortly to be made on certain street-car lines, and other roads are contemplating a change from mule power to electricity. These undertakings are of interest to manufacturers of electrical material in this country, as large quantities of such supplies will be needed. The manager of the new electrical company has informed the United States Consul at Madrid that they intend to purchase about 75 per cent. of the material needed by them in the United States.

EQUIPMENT WANTED FOR JAPANESE ROAD.—Inquiries are now being made here for the initial equipment, etc., which is intended to be untilized in the construction and installation of a new electric traction system for Yokohama, Japan. The name of the concern which proposes to build the road is the Yokohama Electric Tramways. The existing capital has been furnished by Japanese, but it is anticipated that foreign money will be introduced into the enterprise, later on. The present specifications, which are in the hands of the American Trading Company, Broad Exchange Building, Broad street, and the China and Japan Trading Company, Limited, whose New York offices are at 32 Burling slip, etc., call for an expenditure of 200,000 yen—about $100,000.

BIG CONTRACT FOR SHAW CRANES.—Manning, Maxwell & Moore, of 85-87 Liberty street, New York City, have secured a contract from the Colorado Fuel and Iron Company for the installation in the new extension of the rod, sheet and tin-plate plants at Pueblo, Colo., of 18 electric traveling cranes, to be manufactured by the Shaw Electric Crane Company, of Muskegon, Mich. There will be one crane of 25-ton capacity, to be operated by a 45-hp motor; six 20-ton outfits, each having 40-hp motors; the same number of cranes of 15-ton capacity, to be driven by 25-hp motors; four of 10-ton each, with motors of 18-hp each, and one 5-ton crane, to be worked by a 12-hp motor. The value of the contract is $92,000.

THE MAGNETO ELECTRIC COMPANY will establish a factory at Amsterdam, N. Y., for the manufacture of its apparatus which relates to commercial telegraphy, fire alarm systems, railway semaphores and everything in the signal line. By the Magneto Company's system signals are operated without the use of batteries. The system was described and illustrated in ELECTRICAL WORLD AND ENGINEER of Dec. 1, 1900.

THE MILLER IMPROVED GAS ENGINE COMPANY, of Springfield, O., whose plant was destroyed in the recent fire in that city, has let contracts for the erection of a new plant of double the capacity of the old. The main building will be of brick, 300 x 73 feet. It will be equipped throughout with new machinery, now being ordered, and it is the intention to have the plant in full operation by July 1.

TO EXTEND PLANT.—The Warren Electric Manufacturing Company, Sandusky, O., will build a large addition to its plant. It will be 140 x 40 feet, two stories high, of brick and stone.

BRITISH GOVERNMENT ORDERS FOR AMERICAN MACHINERY.—Charles Churchill, managing director of Charles Churchill & Company, Limited, of London, etc., which concern represents the British interests of over 100 American machine tool manufacturers, and is the largest handler of Yankee labor-saving devices in the United Kingdom, is now on a visit to the United States. In an interview, Mr. Churchill said: "The prejudice which American machinery was subject to a few years ago is now practically a dead letter. I should say that over 300 manufacturing firms in Great Britain use American tools. The government has been quite an extensive purchaser since the outbreak of the war in South Africa, and hardly a day has passed for the last two years without our having secured an order for various American devices to be installed at the Woolwich Arsenal. We have had orders for lines of tools varying from lathes for the ordinance shops to smallest wire twist drills, to be used for making cartridge fuses. Recent contracts call for four No. 2 milling machines, to be built by the Cincinnati Milling Machine Company. The Morse Twist Drill Company, of New Bedford, Mass., is furnishing several twist drills. The Warner & Swasey Company, of Cleveland, O., is supplying some brass working machinery. Ten 16-inch screw cutting lathes, manufactured by the Hendey Machine Company, of Torrington, Conn., are also to be installed in the ordnance shops at Woolwich. The London Mint is also being equipped with some half-dozen annealing furnaces, built by the American Gas Furnace Company, of Elizabethport, N. J. Owing to the war, the demand for tools to be installed in big industrial plants has been somewhat meagre, but the loss in trade was supplied by the increased demand for machinery for arsenal use. Now that hostilities are pointing to a happy termination, we look for a decided revival in business all round. I should say that not one-twentieth of the plants in Great Britain have as yet a single American piece of machinery, so that American manufacturers of labor-saving devices have a wide field before them in the United Kingdom. Contracts lately taken for machine tools to go into British industrial plants include orders for 24-inch, 30-inch and 32-inch lathes, to be installed in large Glasgow engineering works and in the Oldbury Carriage Works. The American Turret Machine Company, of Wilmington, Del., will build them. We have also secured orders aggregating about $75,000 worth of various machinery for installation in the new Rugby works of the British Thomson-Houston Company, Limited." Mr. Churchill, who is making his headquarters at the New York offices, 23 John street, of the American Gas Furnace Company, will next week visit New Bedford, Mass; Providence, R. I.; Worcester, Mass.; Hartford and New Haven, Conn. On the 28th inst. he leaves New York for the West. He will visit Cleveland and Cincinnati, and on his return will stop at Philadelphia and Wilmington. He will sail for Europe May 24.

ANOTHER BIG MEXICAN WATER-POWER SCHEME.—One of the most interesting of the several important enterprises backed with American capital for the purpose of utilizing water power in Mexico for the generating of electricity is projected by the Guanajuato Power & Electric Company, recently incorporated, with a capital of $3,000,000. The company has acquired the franchises originally granted by the State authorities of Guanajuato to Francisco Garcia and Carlos M. Reibio, both of the city of Guanajuato. It is proposed to erect a plant having a capacity of 12,000-hp at a point located about 125 miles distant from the city of Guanajuato. The power will be used for various purposes in eight cities and their vicinities. The existing horse tramways in the city of Guanajuato will be electrically converted and supplied with power from the Cemora plant. The power is also to be made use of for the purpose of operating mines in the neighborhood of Guanajuato, which city has a population of some 60,000 inhabitants and is the center of one of the most important mining regions in the Southern Republic. It is also proposed to supply electric energy for many of the manufacturing plants in and around the city and to furnish power for lighting purposes. In the first instance, it is anticipated that the city of Guanajuato and its immediate neighborhood will utilize 2000-hp. The flourishing city of Leon, also situated in the State of Guanajuato, will also be supplied at the outset with about 2000-hp for the purpose of operating the tramways, which will be changed from the present mule system, and for the several industrial plants which abound in that city, and for light. The growing cities of Penjamo, Irapuato and Salao and their neighborhoods, as well as three other towns located in the State of Guanajuato, will have the remainder of the power distributed among them. The current is to be carried to the city of Guanajuato by a transmission line of 125 miles. This will be the second longest transmission line in the western hemisphere, the record so far being held by the Bay Counties Power Company's line in California, 222 miles in length. While it has not yet been determined on what the exact voltage will be of the Mexican line, it can now be said that it will not be less than 40,000 volts, and that it is likely to be nearly 60,000 volts. The equipment of the Guanajuato Company's plant will include three-phase General Electric apparatus. The contract for the turbines, etc., has not yet been decided upon. The principal parties interested in the Guanajuato Power & Electric Company include Mr. Charles A. Coffin, president of the General Electric Company; Messrs. Curtis and Peck, who are largely interested in Denver electric traction systems; Mr. Bonwright, a prominent Denver banker, and Mr. Adams, a well known Boston capitalist. The entire system is expected to be in working order inside of two years, and is estimated to cost fully $2,500,000.

ELECTRICITY IN RAILROAD SHOPS.—Two important contracts for electrical apparatus for operating railroad shops have been secured latety by Westinghouse, Church, Kerr & Co., including complete generating plants as well as motor equipments. This apparatus will be installed in the new shops of the Union Pacific Railroad Company, at Omaha, and the Oregon Short Line Railroad Company, at Pocatello, Idaho, and will consist of Westinghouse machines throughout—engines, generators and motors. It is proposed to adopt direct-driven tools wherever possible, as it is believed that under this plan better results can be obtained, everything considered, than through any other form of equipment. The plans for the installations provide for up-to-date shops in every particular. The equipment for the Union Pacific Company's new shops, at Omaha, will contain two compound engines directly connected to 250-kw. 250-volt engine-type generators, and one compound engine, directly connected to a 75-kw. 250-volt generator. These engines are to run non-condensing under a boiler pressure of 150 pounds. The contract also covers 21 shop motors of various sizes, from 5 to 25-hp. The generating sets are to be of regular engine-type construction, with bed plates. The Oregon Short Line contract covers two standard engine-type outfits for direct connection to 150-kw. 250-volt generators, and one "Junior" engine for direct connection to one 50-kw. 250-volt generator, the engines to be of the regular Westinghouse construction with bed plates. The contract also covers 12 shop motors of various sizes. These engines will operate non-condensing under a boiler pressure of 100 pounds. Under both of these contracts the Union Pacific and Short Line companies will use Westinghouse motors for all individual direct-driven tools. This means 21 motors for Omaha, ranging from 5 horse-power to 25 horse-power, and 12 motors for Pocatello, ranging from 5 horse-power to 25 horse-power.

HIGH HEAD DEVELOPMENT ON THE PACIFIC COAST.—The long-distance electric power transmission companies of the Pacific Slope are now reaching far back in the Sierra Nevadas for their water supply, and are utilizing the water under extremely high pressures, which a few years since would have been considered impracticable. The latest development is a contract which has been placed with the Abner Doble Company, of San Francisco, by the Bay Counties Power Company, of California, for two water-wheel units of 3,700-hp each, to operate under an effective head of water of 1,600 feet. These will be the largest single tangential water-wheel units ever installed, and will be equaled only by the 5,000-hp turbines at Niagara. The 2,000 kw. 240-rpm generators for these units will be furnished by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and the main shafts will be made by the Bethlehem Steel Company, of their high carbon, open-hearth, annealed, oil-tempered nickel steel. Throughout, the apparatus will be designed on best engineering lines, with a view of securing the highest possible efficiency.

BELL TELEPHONE OUTPUT.—The instrument output of the American Telephone & Telegraph Company for the month ending March shows a gross output of 96,557 instruments. This is a record-breaking exhibit, the nearest approach to it being that for the month of June, 1901, when the output aggregated 96,300 instruments. The number of returned instruments was, however, considerably in excess of the average monthly returns, and hence the net results were not much beyond the ordinary. The statement, as compared with last year, shows an increase of 19,806 in gross output since Dec. 20. The gross output for the year 1902 was 279,553, a gain of 63,444. The net output was 114,498 and the total outstanding is 2,691,065, a gain of 611,567.

BALL ENGINES.—The Wallaceburg Sugar Company, Limited, of Wallaceburg, Ont., which is building a beet sugar works, will install an electric power plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., and direct-connected to Crocker-Wheeler generators. The Eaton Sugar Company, now building a beet sugar works at Eaton, Colo., has purchased for its electric plant two direct-connected outfits, the engines being built by the Ball Engine Company. The Minneapolis General Electric Company, Minneapolis, Minn., is installing two vertical cross-compound Ball engines, direct-connected to General Electric generators.

SHANGHAI TO HAVE MOTOR CARS.—The Municipal Council of Shanghai have abandoned the idea of the construction of electric tramways, and are now prepared to receive offers for a motor car omnibus concession. Mr. Fearon, of Fearon, Daniel & Company, who is now in China, has acted in several instances as chairman of the meetings held there, for the purpose of considering the matter of adopting occidental modes of transit. The New York offices of the company are at 87 Front street.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The project of building a telephone line to connect La Grange and Cooperstown, Calif., is being promoted by James McMahon. The line will be 7 miles in length.

SAN FRANCISCO, CALIF.—The San Francisco Board of Supervisors has asked the City Attorney for advice as to their power to grant the telephone franchise which M. Adrian King has applied for. The same promoter obtained and sold a valuable telephone franchise in Los Angeles a short time ago.

LOUISVILLE, KY.—The Louisville Independent Telephone Company will arrange for a $1,000,000 mortgage on its plant in the near future. The company's new exchange will soon be ready for operation.

ST. JOHNS, MICH.—The Union Telephone Company has increased its capital stock from $250,000 to $400,000.

SAGINAW, MICH.—The directors of the Valley Telephone Company, at a meeting held recently, authorized the expenditure of $75,000 in expansion during the next few months. The company occupies the territory in the extreme eastern part of the State.

BELDING, MICH.—The new exchange of the Citizens' Telephone Company here was formally opened April 1. The exchange starts with 120 subscribers, which is a large number for a town of less than 5000 population. Service was not charged for up to April 1, but collections will be made for this quarter.

ALBION, MICH.—A committee of local business men and other citizens is organizing an independent telephone company here. A mass meeting was held at the Opera House recently, which was addressed by Manager E. B. Fisher, of the Citizens' Company of Grand Rapids, and Manager J. B. Ware, of the Detroit Independent Company. Connections with the independent toll line systems of the State are promised if a good exchange warrants them, and enthusiasm is at a high pitch.

DETROIT, MICH.—The Wayne County Circuit Court has granted a mandamus requiring the Michigan Telephone Company to extend to the remaining subscribers of the late Detroit Telephone Company, which was absorbed by the Michigan Company, its full service and connection. A few months ago the Michigan Company installed a new switchboard, raised its rates and cut off from connection the remaining subscribers of the Detroit Company. The Court holds that, as the successor of the Detroit Company, the Michigan Company bound itself to the terms of the Detroit franchise and must furnish service at the rate given by the old company.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of this city, has booked 800 new orders since December 1. On April 1 the number of telephones connected with the regular exchange service was 4,150, and a large force of installation men is at work in the city, operating in conjunction with a special crew of linemen. A new directory will be issued in May, which is expected to contain nearly 4500 names. This is a large number for an exchange in a city of 90,000 where two companies are operating. The growth is undoubtedly due in part at least to the advance made in the rates by the Michigan Telephone Company, representing the old Bell interests, which took effect Jan. 1.

ALMA, MICH.—The Union Telephone Company, which occupies the independent field in Shiawassee, Gratiot, Isabella, Clair and Saginaw counties, and portions of Ionia and Montcalm counties, held its annual meeting here a few days ago and elected the following officers: President, S. E. Parkill, of Owosso; vice-president, J. P. Gibbs, of Edmore; secretary, Thomas Bonley, of St. Johns; treasurer, Garret S. Ward, of Alma; general manager, C. O. Trask, of Alma. The capital stock was increased from $250,000 to $400,000, and several important extensions and improvements were authorized. This company occupies the field extending through the central portion of the State, from the Grand Rapids & Indiana Railroad to the territory occupied by the Valley Telephone Company's system.

ST. PAUL, MINN.—Amended articles of incorporation were filed at the office of the secretary of state recently by the Central Minnesota Telephone Company, of Willmar, whereby its capital stock is increased to $575,000, of which $50,000 is to be special, $300,000 preferred, and $225,000 common stock. This company operates several telephone systems which radiate from Willmar.

BUFFALO, N. Y.—The Frontier Telephone Company, which is preparing to build an independent exchange in Buffalo, has placed a contract for switchboards with the Kellogg Switchboard & Supply Company. The initial installation will have a capacity of 18,000 lines and, it is stated, will be the largest single multiple board ever built.

PILOT MOUNTAIN, N. C.—The Farmers' & Merchants' Telephone Company is constructing a telephone line from this city to Ararat, N. C. This company is extending its lines in all direections.

RALEIGH, N. C.—The long contested suit of the American Electric Telegraph Company against the Raleigh Telephone Company for a switchboard was compromised recently. Four thousand dollars were involved.

ROXBORO, N. C.—Mr. W. W. Shaw, superintendent of the Interstate Telephone Company, has been in Roxboro, N. C., looking into telephone matters. It is probable that Roxboro may have a telephone system established by the Interstate Company.

RALEIGH, N. C.—The final connections have been made between Greenville and Kinston, so that the long-distance service of the Henderson Telephone Company is now in practical operation to Morehead City, and all intermediate points. The main line of the company extends from Chase City, Va., to Morehead, N. C. The principal points reached by the line just completed are Rocky Mount, Greenville, Wilson, Washington, Trenton, New Bern and Morehead City.

SHELBY, OHIO.—The Shelby Electric Company will build a brick and stone addition to cost $5,000.

MARION, OHIO.—The Marion Telephone Company has increased its capital stock from $5,000 to $10,000. Fred E. Guthery is president and Frank Crow, secretary.

CONVOY, OHIO.—The Convoy Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 100-line magneto, self-restoring drop board.

HASKINS, OHIO.—The Haskins Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a new magneto system switchboard with 100 drops.

CLEVELAND, OHIO.—The annual convention of the Ohio Telephone Association will be held about the middle of June this year. The exact date and place have not been decided upon.

PEMBERVILLE, OHIO.—The Bradner Telephone Company, of Bradner, has bought the Pemberville exchange, including the lines connecting this place with Woodside, Scotch Ridge and other places.

NORWALK, OHIO.—The Norwalk Local Telephone Company has been incorporated, with $250,000 capital stock, to furnish telephone service in Norwalk and surrounding towns. A. M. Beatty and J. F. Laning, of Norwalk, are the chief promoters.

TOLEDO, OHIO.—J. W. Cherry, manager of the Toledo plant of the Bell Company, has been made manager of the Toledo district, including several counties in Northern Ohio. T. P. Ryan, formerly assistant manager, has been promoted to the position of manager.

CANTON, OHIO.—Mr. George Holmes, manager of the Canton exchange of the Central Union Telephone Company, has been appointed district manager for Stark, Wayne and Holmes counties, including about 12 exchanges. His headquarters will continue at Canton.

DEFIANCE, OHIO.—The Defiance Grocers' Association has adopted resolutions agreeing to drop the service of the Bell Company because it has increased its rates. The business will be given to the Home Company, which now has about 600 subscribers, and is growing rapidly.

CLEVELAND, OHIO.—The Century Telephone Construction Company is installing 200-line common battery boards for the Valley Telephone Company at Waverly, Athens and Sayre, N. Y. It has a large force at work on a 1000-line board for the Utica Telephone Company, Utica, N. Y.

HAMILTON, OHIO.—President Bake, of the new Hamilton Home Telephone Company, states that over 600 subscribers have been secured. A building has been leased for an exchange and work of laying conduits will start at once. The exchange is being built by the Northern Construction Company.

BUCYRUS, OHIO.—The directors of the Bucyrus Telephone Company have decided on important improvements. Contracts will be placed for 5000 feet of overhead cable to supply telephones in the second and third wards. The company has over 700 telephones in use and will install over 100 more when the cables are up.

MARION, OHIO.—The Marion County Telephone Company, which will build an extensive system in Marion County, has placed a contract with the Sterling Electric Company, of Lafayette, Ind., for switchboard, telephones and other equipment. The Marion Company has arranged for exchange quarters in the new Masonic Temple.

MANSFIELD, OHIO.—R. S. Teeple, a taxpayer, has brought suit to secure the forfeiture of the franchise whereby the Central Union Telephone Company operates in Mansfield. He claims that the original franchise, which was secured by the Midland Telephone Company, was never assigned to the Central Union Company; also that the latter is furnishing inferior service.

TOLEDO, OHIO.—The Toledo Telegraph, Telephone & Messenger Company will spend $100,000 in a plant and will operate messenger service wires. It will have branch offices in the surrounding towns and hamlets which will be connected by telephone lines. The business will not interfere with that of the telephone companies. L. P. Harris, J. H. Bellows, A. M. Hough and others are interested.

ROCKY HILL, OHIO.—An important community system is being built in Gallia and Meigs counties, centering at Rocky Hill. Each line is built by a company of 15 persons who furnish their own telephones and material. Lines are being built to Keystone, Camba, Thurman, Berlin and Jackson and others are projected. It is the intention to install an exchange to afford better intercourse among the various lines.

CADIZ, OHIO.—The Harrison County Telephone Company has elected officers as follows: Ralph Cunningham, president; W. W. Wright, vice-president; W. W. Potts, secretary; J. M. Schreiber, treasurer. The above, with A. J. Vereiner and George Probeck, are directors. The company declared its second semi-annual dividend March 1. It is at present engaged in building a toll line from its exchange at Jewitt to Scio by way of New Rumley.

TOLEDO, OHIO.—The Toledo Home Telephone Company has filed a mortgage for $2,500,000. The Central Construction Company built the plant. Securities are now being distributed to Toledo subscribers by the National Bank of Commerce. The Company held its annual meeting a few days ago and elected these officers: E. L. Barber, president; M. V. Barbour, vice-president; James S. Brailey, jr., treasurer; Robert E. Hamlin, secretary-manager.

CANTON, OHIO.—Representatives of the Board of Trade and the Business Men's Association have taken an option on the property of the Stark County Telephone Company, which includes the local exchange. It is proposed to organize a company with practically every subscriber as a stockholder, and purchase the property from the Federal Telephone Company. Members of the Business Men's Association and physicians have ordered Bell telephones taken from their residences and places of business.

ELYRIA, OHIO.—The American Construction & Trading Company, of Elyria, which is building telephone exchanges at Albany, Schenectady and Cohoes, N. Y., for the home companies of these cities, has placed contracts with the Kellogg Switchboard & Supply Company for switchboard apparatus. At Albany there will be a multiple central energy board of 7200 drops capacity and the exchange will start with 2100 lines. The Schenectady board will have a capacity of 4800 lines and 1000 will be installed, and the Cohoes board will have 2400 lines with 800 installed.

SANDUSKY, OHIO.—The Ohio interests of the Central Union Telephone Company have been divided into four divisions, with headquarters in Cleveland, Sandusky, Dayton and Columbus. A. J. Mellen, heretofore manager at Sandusky, has been made manager of the Sandusky division, in charge of exchanges in Erie, Lorain and Huron counties. The past year has been the best the company has ever known in Sandusky, and a large number of new subscribers has been added to the list.

OTTAWA, ONT.—The Bell Telephone Company contends that, under its Dominion charter, it has power to use the streets of every municipality in Canada in perpetuity, but a judge of the Court of King's Bench for Ontario has just decided to the contrary. The judgment was rendered in a stated case of the City of Toronto vs. the Bell Telephone Company and will practically give the whip handle to the municipalities.

CHARLESTON, S. C.—The Southern Independent Telephone Association was formed here recently at a meeting of representatives of independent telephone companies from North and Carolina, Georgia, Florida and Virginia.

AUSTIN, TEX.—The following appointments of officials of the Southwestern Telegraph & Telephone Company, which operates in Texas and Arkansas, have just been announced: Joseph E. Farnsworth, general manager, with headquarters at Dallas; T. L. Powell, superintendent Arkansas division, with headquarters at Little Rock; T. W. Milburn, superintendent North Texas division, with headquarters at Dallas; E. K. Baker, superintendent South Texas division, with headquarters at Austin; C. A. Gates, superintendent long-distance service; P. E. Hurson, superintendent of equipment; B. H. Johnson, superintendent of construction. The offices of general superintendent and superintendent of construction of the South Texas division have been abolished.

AUSTIN, TEX.—The energy and activity of the numerous independent telephone companies which have invaded the Texas and Arkansas field during the past two years has caused the Southwestern Telegraph & Telephone Company to take steps looking to extensive improvements and additions to its system in Texas and Arkansas, in which it operates. Messrs. T. B. Dolittle and Thomas Cotter, of Boston, Mass., who are in the employ of the parent company, of which the Southwestern Telegraph & Telephone Company is a part, are now making a tour of Texas for the purpose of investigating the physical condition of the properties of the corporation with a view to making recommendations and estimates for important extensions of toll lines and a general improvement of the system in that State. These two gentlemen have already completed their inspection work in North Texas and have submitted and had approved by the Boston office an estimate for improvement aggregating $250,000 in the northern part of Texas. It is expected that nearly one million dollars will be expended in Texas and Arkansas within the next year by this company.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is installing new instruments at the rate of ten a day in Salt Lake and the immediate vicinity. The Company has begun the construction of a line between Great Falls and Ft. Benton, Mont., a distance of 43 miles.

SALT LAKE CITY, UTAH.—The Midway Telephone Company has incorporated in Portland, Ore.; capital, $4,000. Incorporators, H. V. Gates, H. M. Gates, W. E. Pruyn, O. E. Gates and C. Cogswell.

SALT LAKE CITY, UTAH.—The Union Pacific Railroad is constructing an independent telephone line between Laramie and Cheyenne, for local business only. This line will not be associated in any way with the movement of trains.

SALT LAKE, UTAH.—The Montana & Wyoming Telephone Company, which is fighting the Rocky Mountain Bell Telephone Company in the Northern part of Wyoming, has secured a franchise from the Council of Cody, Wyo., to erect and maintain an exchange in that place. The franchise is exclusive for three years.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has started a crew from Blackfoot to extend the Hailey line westward to a connection with Boise, Idaho. Later a crew will work from the other direction to close up the gap of 150 miles which will give Salt Lake connection with all of the Western Idaho circuit.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed at Spokane, Wash., for the Washington Water Electric Power Company, by which the company takes power to do business outside of the State of Washington, and also to enter the telephone business. The company will install a telephone line to the Cœur d'Alene country, also to a number of towns en route.

SALT LAKE CITY, UTAH.—T. N. Terrell, contractor on the Thunder Mountain (Idaho) telephone line has started work. Work will commence on the Idaho City end and will be pushed as fast as possible. It will follow the present wagon road to Bear Valley, thence to Thunder Mountain. The Rocky Mountain Bell Telephone Company is behind the enterprise.

SALT LAKE CITY, UTAH.—The Utah Home Telephone Company will apply for franchises in the cities of Ogden, Logan, Park City, Burgham and other municipalities in the State. As soon as these franchises are granted the company will commence work, involving an expenditure of at least $1,000,000. The company's charter provides for conducting, besides the business of furnishing telephone service in Utah and all other States adjacent, the furnishing of electric current for light and power and the operation of electric railways.

CHARLESTON, W. VA.—The Charleston Telephone Company, which has recently succeeded the Kanawha Telephone Company, has cut in about 675 lines in its new system, which will have 1200 lines to start with. The system will tap all the coal country in its section and lines will be built to Huntington, to connect with the system of the United States Telephone Company. The company is installing Kellogg apparatus.

ELECTRIC LIGHT AND POWER.

EUFAULA, ALA.—The City Council has under consideration two propositions for lighting the city, and will meet soon to decide the matter. The Atlantic Electric Light Company has also submitted a proposition to build a new plant to be owned and operated by the city.

SAN FRANCISCO, CALIF.—The City Council of Whatcom, Wash., has granted the franchise permitting D. O. Mills, Alvinza Hayward and P. B. Cornwall to erect electric power lines and engage in supplying electric light and power. Current will be transmitted about 42 miles from a 10,000 hp electric power plant, which will be installed at Noaksack Falls. A line will also be constructed to Everett, the distance being about 45 miles. A franchise has been granted by the city authorities of Everett, who have refused to grant a similar franchise to the Snoqualmie Falls Power Company. An electric branch of the Bellingham Bay & British Columbia Railroad will be operated.

CITY OF MEXICO, MEX.—The Governor of the State of Zacatecas, Mexico, has just granted a concession to Cleofas Galvan for the installation of an electric power and light plant at San Geronimo, that State. The plant will have a capacity of 1500 hp. Nearly all of this power has been contracted for by various mining companies of that section. Under the terms of the concession the enterprise is exempt from all State and municipal taxation for a periad of 20 years.

SHELBY, N. C.—Shelby is to have a first-class system of electric lights. The plant of the Shelby Light & Power Company has been purchased by Messrs. A. W. McMurry and Hugh G. Miller, and these enterprising young business men will give the town and all subscribers good service.

MONTREAL, QUE.—At the next session of the Quebec legislature, power will be asked to authorize the city of Montreal to force the placing of all electric wires in the city in underground conduits.

NAVARRE, OHIO.—A Council Committee has been appointed to prepare an ordinance and secure estimates for electric lighting.

CLEVELAND, OHIO.—A. L. Clark, treasurer of the National Soldier's Home, Montgomery County, Ohio, has advertised for bids for the equipment for an addition to the lighting plant.

CALEDONIA, OHIO.—The Council is sending a committee to a number of towns in the State to investigate the cost of a municipal lighting plant. A proposition made by Mansfield parties is being considered.

GENEVA, OHIO.—The Geneva Illuminating Company, of Cleveland, has been incorporated by A. M. Snyder, A. A. McCaslin, H. B. Potter, Robert Crosser and L. M. Hildreth. The company is building a lighting plant at Geneva.

COLUMBUS, OHIO.—A bill has been introduced in the Ohio Legislature providing that where a village or town decides on municipal ownership of electric lighting plant, it shall purchase that already established. If the parties cannot agree, the matter is to be left to the Probate Judge.

MARTIN'S FERRY, OHIO.—Bids for improvements to the municipal lighting plant have been opened. The Warren Electric Manufacturing Company, of Sandusky, was given the contract for an alternating current machine. Contracts for engines, boilers and other equipments have not yet been awarded.

JEANNETTE, PA.—A large amount of electrical equipment will be installed in the new plant to be built at Jeannette, Pa., by the Pennsylvania Rubber Company, of Erie. F. A. Wilcox, of Erie, is the engineer in charge of plans.

AUSTIN, TEX.—Messrs. Carl F. Drake, of Austin, and J. W. Maxey, of Houston, have entered into a contract with the City Council of Elgin, Tex., to establish and operate an electric light and power plant at that place.

SALT LAKE CITY, UTAH.—W. W. Stevens, of Grangeville, Idaho, has asked the City Council for a franchise for an electric light and power plant. As a counter proposition Mr. Van Buren, the manager of the present electric light plant, has promised the city free street lighting for one year, with privilege of continuing the same thereafter, provided no new franchise be granted.

RICHMOND, VA.—A charter has been applied for by the Interurban Electric Company, Joseph Wallerstein, T. William Pemberton, John Adams, J. Stanton Moore, Milton E. Marcuse and Allen G. Collins, all Richmond people, composing the company. The charter provides for an electric plant in the city of Richmond and in the counties and villages of Virginia. The company will operate an electric light, heat and power plant. The stock is limited to $300,000.

SEATTLE, WASH.—The Citizens' Light & Power Company, a new company in Seattle, has concluded negotiations for a purchase of a site for a plant.

VANCOUVER, WASH.—The City Council of Vancouver, Wash., has decided to sell the city electric light plant with the exception of the real estate composing its site. Sealed proposals will be received until April 21 for the purchase of the system. The purchaser will be granted an exclusive electric lighting franchise for a period of 15, 20 or 25 years, according to the terms of the bids. He will be required to establish an electric light plant of sufficient capacity for all commercial and city needs. The city is to be furnished with 50 arc street lights and the number increased as the city may require. A number of incandescent lights must be donated to the city.

EVANSVILLE, WIS.—The city is figuring to buy the electric light plant in this city.

RANDOLPH, WIS.—There is talk of a municipal water-works and electric light plant here.

MILWAUKEE, WIS.—The organization of an independent electric lighting plant for the south side is now planned. The plant will take care of the entire commercial requirements and eventually bid for the city street lighting.

CHEYENNE, WYO.—The Union Pacific Railroad will construct a central power, heating and lighting plant for its shops and buildings at Cheyenne. Twelve large boilers will be installed.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Copper Belt Railway & Power Company will issue bonds to the amount of $2,000,000, and proceed to install an electric power plant on the McCloud River in Shasta County, Calif. The first plant to be installed will have a capacity of about 6,000 hp, and further hydraulic development will increase the capacity to 16,000 hp. An electric railway from Bully Hill to Kennett is projected, which will haul ore from the De Lamar mines to the Southern Pacific Railroad, a distance of about 21 miles. Boston capitalists are backing the enterprise.

SAN FRANCISCO, CALIF.—The directors of the Market Street Railway, which is now owned by the United Railroads of San Francisco, has let the contract for the construction of an additional electric power station. The contract price is $127,500. The company now has three electric power houses, with a combined capacity of 9500 hp. The largest has a 7000-hp equipment. The new station will have room for the installation of a 16,000-hp plant. Contracts have been let for two 1250-kw engine-driven General Electric 13,000-volt 3-phase generators, three 750-kw motor-generators and boilers and engine.

ATLANTA, GA.—The extension of the line of the Atlanta Railway & Power Company from East Point to College Park will begin at an early date, and will be completed by summer. The work will begin early in the spring.

LEXINGTON, KY.—The Blue Grass Consolidated Traction Company, which proposes to build an extensive electric system in central Kentucky, has commenced actual construction work on the line to Versailles. Offices have been established in Lexington and plans are being prepared for an immense power station.

ALBANY, N. Y.—The North River Railroad Company has been incorporated, with a capital of $180,000, to operate a street surface road 18 miles long from Saratoga Springs to South Glens Falls. The directors are Byron J. Town, John W. Howe, William F. Town, F. G. Howland, W. L. Rich, J. P. Wemple, J. H. Mabbett and H. C. Todd, of Saratoga Springs, and J. S. White, of South Glens Falls.

WARREN, OHIO.—The Trumbull Electric Railway has been granted a franchise to extend its line through Warren. The company is building an extension to Leavittsburg.

LIMA, OHIO.—The Western Ohio Railway commenced operations from Lima to Wapakoneta and St. Mary's a few days ago. The line will be opened to Minister in a few weeks.

SPRINGFIELD, OHIO.—The Springfield & Washington Traction Company has been incorporated by D. K. Gotwald, O. F. Dillman, L. B. Corry, Charles Orr, W. D. Riddell, W. A. Fry, and C. N. Slyer; capital stock, $10,000.

DELAWARE, OHIO.—The Delaware Street Railway has been sold to J. G. Webb, representing the Columbus, Delaware & Marion Railway Company, which has had the property under option for some time. The price was $50,000.

SEBRING, OHIO.—The Village Council is advertising for bids for the construction of a railway over route No. 1. This route is desired by the Stark Electric Railway Company, which is building a line from Sebring to Canton and Alliance.

DAYTON, OHIO.—The Dayton & Kenton Traction Company is making rapid progress in securing right of way and making surveys. The line will embrace 125 miles of track. The contract with the Falk Brothers Construction Company calls for the completion of 70 miles of road this season.

MANSFIELD, OHIO.—The recently organized Mansfield, Mt. Gilead & Delaware Traction Company has selected directors as follows: W. W. Stark, W. M. Wisely, W. J. Burket, Frank Fenstermacher, C. E. Fritzinger, C. W. Fritz, of Mansfield, and H. B. McMillian, Mt. Gilead. W. W. Stark is president of the company.

EAST LIVERPOOL, OHIO.—Extensive improvements will be made to the East Liverpool & Rock Springs Railway. A portion of the road will be double-tracked, new trolley wire will be put up, several new cars have been ordered and the trucks in use will be replaced with new McGuire trucks. A faster schedule will be adopted.

WARREN, OHIO.—The Conneaut & Southern Railway Company has applied to the Trumbull County Commissioners for a 50-year franchise for a line to run through Kinsman, Berg Hill, Hartford and Vienna on to Youngstown. The company desires to furnish light and power in towns along the route and agrees to give a five cent-fare between two adjoining points.

SCRANTON, PA.—The strike of the street railway employes here, which has been on since last September, was declared off on April 6. All old employes are to be taken back at the present scale of wages; old employes are to have preferred runs; the road is to be an "open" one, and there will be no formal recognition of the union.

NEWPORT NEWS, VA.—The Jamestown, Yorktown & Old Point Railway, which proposes to take in the lower peninsula cities and towns, has about decided upon its plans for the road, plant and equipment. R. T. Pierce is chief engineer for the road.

KENOSHA, WIS.—The Kenosha Street Railway Company has mortgaged its entire property in order to raise funds for completing its road.

MILWAUKEE, WIS.—The town board of the town of Greenfield has been asked for a franchise for the extension of the Milwaukee Electric Railway and Light Company's system at that point.

FOND DU LAC, WIS.—The Fond du Lac Street Railway & Light Company will increase the capacity of its plant in order to supply power for the Fond du Lac-Ohkosh Interurban Electric Railway.

NEW INDUSTRIAL COMPANIES.

THE UNITED MARINE MANUFACTURING AND SUPPLY COMPANY has been incorporated at Albany, N. Y.; capital, $5,000. Directors: A. C. Jahl, New York; C. P. Brooks, East Orange; S. C. Weinberg, Brooklyn.

THE SPENCER AUTO-VEHICLE COMPANY, to manufacture and deal in automobiles and other vehicles, has been organized at Portland, Me.; capital stock, $500,000; president and clerk, Seth L. Larrabee, Portland; treasurer, W. F. Rogers, New York.

UNION RAILWAY POWER & ELECTRIC CO.—At Trenton, N. J., on April 12th, the Union Railway, Power and Electric Company, capital $6,000,000, was incorporated. The company is to furnish and generally deal in electrical, chemical, and mechanical power. The incorporators are Nelson R. Vanderhoof, W. Mands Green, and Edward Cuddy.

PERSONAL.

LORD KELVIN. Among the passengers on the Cunard Line steamer Campania, which sailed from Liverpool on April 12 for New York, were Lord and Lady Kelvin.

MR. HERBERT B. MOSES has accepted a position as electro-chemical engineer with the National Storage Battery Co., at Buffalo. Mr. Moses is a recent graduate from Sheffield and Gottingen, where he studied under Nernst.

MR. C. CALL, of the firm of Call & Combs, of Wilkesbarre, N. C., the makers of locust pins, etc., was in New York last week looking after some large contracts for his firm. Mr. Call reports the company very busy and the outlook most encouraging.

MR. ADOLPHUS BUSCH, president of the Anhaüser-Busch Brewing Company, St. Louis, Mo., has been elected president of the American Diesel Engine Company, of New York. Col. E. B. Meier has been elected vice-president of the same company.

MR. JOHN I. SABIN, president of the Central Union Telephone Company and of the Pacific States Telephone Company, has been elected president of the Cleveland Telephone Company, one of the sub-companies of the Western Telephone & Telegraph Company.

MR. HOWARD D. MAIZE, who makes a business of financing and handling bonds for telephone and other public service companies, was an interested visitor at the independent telephone convention in Chicago last week. Mr. Maize is located in the Gaff Building, Chicago, and is giving increasing attention to independent telephone securities.

MR. PATRICK B. DELANY, of South Orange, N. J., lectured before Sibley College, Cornell University, on the 11th inst. The subjects covered were control of vibrators, their use in synchronous telegraphy; and rapid automatic telegraphy, the latter method being demonstrated by apparatus in operation showing a speed of transmission of over 7,000 words per minute.

MR. W. S. BARSTOW, the electrical and mechanical engineer, has been appointed consulting engineer to the Hartford Carpet Corporation to build a power plant at their new factories at Thompsonville, Conn. At the present time he is completing a power house at Hammels, Long Island, for the Long Island Railroad Company, which is gradually extending the use of electric traction.

MR. KERN DODGE and Mr. Charles Day, of Nicetown, Philadelphia, have formed a partnership as Dodge & Day, and they describe their professional business as that of "modernizing engineers." Under this original phrase they are devoting their energies to the design and installation of steam and electrical plants, and more particularly to motor drives for factories. They have already done some very interesting work in this respect. Mr. Dodge is the son of Mr. J. M. Dodge, of Link Belt fame.

MR. JOHN LUNDIE, of New York, the well-known consulting engineer, has just been given by the University of Edinburgh, Scotland, the degree of Doctor of Science (D. Sc.) in recognition of his work and researches in the electric traction field. This degree is comparatively rare as conferred on engineers, and is only granted in recognition of original work. Coming from the university of Maxwell, Tait and Jenkin, the degree is particularly gratifying and is a high testimonial to the work accomplished by Mr. Lundie.

PROF. A. G. BELL, president of the National Geographical Society, gave a dinnner at Washington on April 12 at the New Willard, to Commander C. E. Borchgrevink of the steamer Southern Cross of the last antarctic expedition. Among the notable people present were Admiral Dewey, Admiral Melville, Gen. Greely, Marcus Baker, Assistant Secretary of State Hill, Justice Harlan, Walter Wellman, and C. Hauge, Secretary of the Swedish Legation.

MR. JOS. PLATKY, of Lyons, France, is now visiting this country and is making his headquarters at 171 Mercer Street, New York City. He is now engaged as an electrical engineer and contractor at Lyons, but will be remembered by some as one of the early Edison men, having been engaged on stock ticker work in the seventies before he went into the electric lighting field. Mr. Platky is delighted to make this trip to America, and is picking up several novelties for introduction in France on his return.

MR. MARIO BRAGA, electrical engineer for the firm of James Mitchell & Co., of Rio de Janeiro, Brazil, is now visiting this country, and is making his office with Mr. J. J. Hobbs, at 143 Liberty Street, New York City. He will be here about a month and will visit various cities and plants, besides making an investigation as to apparatus, etc. He brings letters of introduction from Dr. Adolf Aschoff, who is very favorably remembered in America by many old electrical friends and acquaintances, and is now connected also with the above named progressive house.

MR. F. L. DAME, who succeeded W. J. Browne as general manager of the Union Electric Company, of Dubuque, Ia., has demonstrated in the reconstruction of the system his ability as an electrical engineer. Mr. Dame went there last May to take charge of the remodeling and reconstruction of the system and the work that has been done, which gives Dubuque to-day one of the best electrical systems in the middle west, has been done under his personal direction. He has been prominently connected in the northwest with Thomson-Houston, General Electric and Westinghouse interests, and has now been expending $150,000 in putting the Dubuque lighting and traction systems into good shape.

MR. S. G. McMEEN, who was for a number of years chief engineer of the Central Union Telephone Company, and who, since the election of Mr. Sabin to the presidency of the Chicago and Central Union Telephone companies, has been connected with the engineering departments of both companies, has recently left the operating field to join the ranks of the engineers of the Western Electric Company, where naturally he feels much at home, having for so long supervised and drawn specifications for the construction of apparatus built by the Western Electric Company for the Central Union Telephone Company. Mr. McMeen was one of the leaders in the founding of the Chicago Electrical Association and is one of the most popular and most resourceful telephone engineers in the middle west.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY of Chicago is sending to the trade this week new catalogues of the Packard incandescent lamps and also a catalogue of full line of Whitney instruments.

WM. J. MURDOCK & COMPANY, Boston, manufacturers of the "solid" telephone receivers, desire to announce that they will open a Chicago office on or about May 1. Mr. V. A. Mayer will be their representative.

GOULD STORAGE BATTERIES.—Among the recent installations of the Gould Storage Battery Co., New York, is that of the Amherst & Sunderland Street Railway Company, Amherst, Mass., which consists of 216 cells type O 513, lead-lined tanks, having a capacity of 100 kw, to be used as a floating battery on the system.

INTERCOMMUNICATING TELEPHONE.—A recent leaflet sent out by the Couch & Seeley Company, Boston, Mass., gives a halftone illustration of an intercommunicating telephone equipped with automatic button switch and automatic re-set. These instruments can be used on either common return or metallic circuits.

AUTOMATIC SWITCHES.—The Automatic Switch Company, 131 Liberty Street, New York, has recently issued two bulletins illustrative and descriptive of the Whittingham mechanically operated reversing switch for electric motors. One style of switch is provided with dynamic break and break resistance. Diagrams show the construction and methods of connecting-up these devices.

MR. A. H. MUSTARD, who formerly represented the Wagner Electric Manufacturing Company in New York, has taken the agency of the Pittsburgh Transformer Company, opening an office at 120 Liberty Street, New York. Mr. Mustard's long acquaintance in the electrical field and his experience in selling machinery bespeaks the success of the Transformer Company in and around New York.

LOUD-RINGING BELL.—The Wotton Electric & Manufacturing Company, Atlanta, Ga., is manufacturing a direct-current bell, constructed on the same lines as the loud-ringing extension bell, for use in noisy places, where the ordinary telephone call-bell cannot be heard. It is operated by two cells of dry batttery, and can be connected to any direct currrent circuit. A circular just issued by the company shows the bell to good advantage.

ELECTRICAL INSULATING CLOTH.—The Mica Insulator Company is sending out samples of its "new process Empire oiled material" for insulating purposes. The base of this material is cloth, which is coated with pure linseed oil. It is flexible and highly finished, and the average breakdown test is stated to be 600 volts per mil. Among the advantages claimed for this material are that it does not crack, harden, become brittle, or deteriorate in any way.

F. B. BADT & CO., Chicago, in addition to the agencies which they have had for some time, including those of the Weston Electrical Instrument Company, and Ward Leonard Electric Company, both of whom have been represented in the west by the firm, have secured the agency for the Osburn Flexible Conduit Company, manufacturers of Flexduct; and for the Perfection Railbond Company, who are making a railbond of the same name. It is claimed that this bond when applied across a railjoint makes a perfect electrical connection.

GARTON LIGHTNING ARRESTERS.—Sales of these arresters are forty per cent greater this year than ever before, and to accommodate its rapidly increased business the Garton-Daniels Company, of Keokuk, Ia., has secured the building next adjoining its present location, and is now occupying the same in addition to its old quarters. With such largely increased facilities it expects to be able to handle orders more promptly than ever, which is saying a good deal, as it claims never to have had an order cancelled in its ten years' history, on account of delay in filling.

PHŒNIX ELECTRIC MANUFACTURING COMPANY.—The Card Electric Company, Mansfield, Ohio, announces that it has sold its manufacturing plant and entire business to the Phœnix Electric Manufacturing Company of that city. The Phœnix Company took possession of the premises on April 1. The change of management brought with it the addition of new capital, which will be employed in the material enlargement of the business, and by the addition of new machine tools and shop equipment it is the Phœnix Company's aim to broaden out into a larger and more extensive field of the electrical industry.

THE NEW EXCELSIOR DRY BATTERY MANUFACTORY, (Salman & McShane, proprietors,) has removed to 32 and 34 Vesey Street, New York City, to much larger quarters than it has been occupying. This concern is to be congratulated on its increased business, which warrants its taking much larger quarters. It has succeeded in having its batteries adopted by many of the leading gas engine, automobile and launch manufacturers. Since February more than 20 additional telephone companies have adopted the battery. Its proposition to send its batteries upon six months' approval to telephone companies of responsibility is proving effective.

B. & C. ELECTRICAL CONSTRUCTION COMPANY.—The B. & C. Electrical Construction Company, which was incorporated recently at Utica, N. Y., has elected officers as follows: President, E. J. Brown; secretary, F. B. Chapman; treasurer, B. V. Butts. The directors are the above officers. B. V. Butts will be the general business manager of the company. The firm will deal in electrical supplies and also supervise the construction of electrical apparatus. The members of the firm are expert electricians, having been in the employ of the Utica Electric Light and Power Company for several years, and are familiar with all the details of the business.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has distributed quite a striking advertisement, it being a large sepia print of an African lion in his cage. The connection between caged lions and Warren specialties is not so self-evident but that the advertisement needs some little explanation. The Warren Electric & Specialty Company says: "As the lion is king of the jungle, so is the Peerless manufacturing establishment the king of its kind, ready to maintain its position at all times and against all comers." This explanation is undoubtedly thoroughly satisfactory to everyone who receives one of the lions, as they are really works of art.

THE HAINES & NOYES CO., Chicago, through its private telephone plant department, has recently closed the following contracts: A large inter-communicating telephone system for the Chicago University, Chicago; a private telephone system for the American Cotton Company, Oklahoma City, O. T.; another large system for Wm. H. Taylor Machinery Company, Allentown, Pa.; a large telephone system for Frank M. Andrews, architect, Dayton, Ohio; the George Watson Paint Company, Chicago. It has also sold a number of telephones to the Metropolitan Elevated R. R., Chicago, and has equipped the United Traction Company, Reading, Pa., with a telephone system for its line.

THE STANDARD POLE & TIE CO., of 44 Broad Street, New York, has received the order from the Dayton, Lebanon & Cincinnati R. R. Co. for the poles to be used on its line now under process of construction. This line is being built by the Appleyard-Green syndicate, the parties who have already built the Dayton, Springfield & Urbana Railroad, and the Columbus, London & Springfield Railway. The Standard Pole & Tie Company's Southern white cedar or juniper poles were used on both of these roads last year, and proved so satisfactory that they were ordered for the new line. In spite of the long freight haul from their point of shipment, the Standard Pole & Tie Co. is able to put these poles into Ohio at prices which compare very favorably with the prices for Northern cedar.

PITTSBURG TRANSFORMER COMPANY.—In a recent review of local industries, the "Pittsburg Leader" has an appreciative article on the above concern, describing the apparatus. In the way of historical remarks, it says: "The Pitttsburg Transformer Company was organized in 1897 by Mr. F. C. Sutter, its members being Mr. E. C. Sutter, Mr. R. V. Bingay and Mr. H. G. Steele, and the able management of these has made the product of the company widely and favorably known. The greater portion of the business of the company is done in the United States and Canada, but a considerable foreign trade is handled by its foreign department in New York. Pittsburg transformers are carried in stock at the agencies of the company in Pittsburg, New York, Philadelphia, Chicago, and San Francisco, thus permitting prompt delivery to customers wherever located."

THE INTERNATIONAL MOTOR CAR COMPANY, Toledo, Ohio, manufacturer of steam, gasoline and electric automobiles, has just issued a quantity of interesting literature. In one of the pamphlets the manufacturing plant of the International Company is described in a very interesting manner, the description being accompanied by some very excellent halftones. The frontispiece is a very pretty picture of one of the Toledo steam automobiles climbing a hill, the view beyond being an attractive one. The various parts of these vehicles are clearly illustrated, and the different styles of the carriages manufactured by this company are also shown. Another pamphlet is devoted entirely to reproductions of testimonial letters, from which it is evident that the Toledo steam carriage is a favorite in all sections of the country. Abstracts from different papers regarding different runs of Toledo automobiles, contests, etc., are reprinted in another of the pamphlets. Altogether the batch of literature forms very interesting reading to anyone who is at all interested in automobile progress.

"KEYSTONE" HAIR INSULATOR.—An article of exceptional interest to architects, builders and prospective owners of all kinds of structures is "Keystone" hair insulator. The problem of insulating buildings against the extreme temperatures of summer and winter is receiving considerable attention. The question of sound-deadening is also one of increasing importance in the residence, schoool, church, hall, and, in fact, all kinds of buildings. The insulation of ice-boxes, cold-storage compartments and buildings to maintain low temperatures produced by natural ice or refrigerating process is also a problem of great importance. Several materials have appeared for the above purpose, but it is claimed that "Keystone" hair insulator is the most successful and economical thus far. In a paper upon insulation of cold storage presented at the October convention of American Warehousemen, at Buffalo, Mr. John E. Starr demonstrated, it is said, the "Keystone" to be from twenty to forty per cent. superior to other materials in the various constructions commonly employed. The exclusive selling right for "Keystone" hair insulator, patented and manufactured by Julius De Long & Co., of Allegheny, Pa., has been secured by the H. W. Johns-Manville Co., which is carrying stocks in various parts of the country for the convenience of their widely extended trade. The H. W. Johns-Manvillle Co., 100 William Street, New York City, will be glad to forward circulars and samples.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 8, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

696,924 BATTERY; W. C. Banks, Brooklyn, N. Y. App. filed Sept. 5, 1900. The copper element is partially submerged and partially exposed to the air in order to absorb oxygen, while the zinc element is wholly submerged, an arrangement by which it is claimed more current and higher voltage are obtained.

696,946. CONTROLLING ELECTRIC MOTORS; W. M. Day, Schnectady, N. Y. App. filed July 12, 1899. A system of motor control having a main generator, two distributing wires and a third wire of intermediate potential, between which latter and one of the outside wires is inserted an auxiliary dynamo giving a voltage half that of the main dynamo.

696,953. TRANSFORMER; A. R. Everest, Lynn, Mass. App. filed Mar. 5, 1901. A transformer core comprising a number of U-shaped laminæ each of which has a long and a short leg, the laminæ being assembled alternately to form two core-legs of the same thickness.

696,958. INSULATOR FOR HIGH POTENTIAL CURRENTS; R. Gaertner, Merkelsgrun, Austria-Hungary. App. filed Jan. 13, 1902. Two bell insulators, one inside of the other, with an air space between.

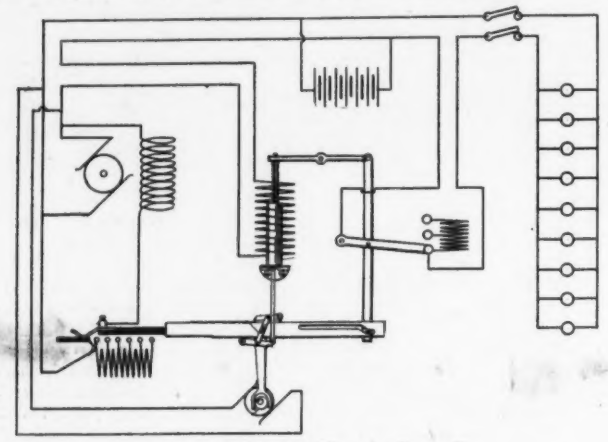
696,963. ELECTRIC SWITCH; G. W. Hart, West Hartford, Conn. App. filed Nov. 19, 1901. Details of a push-switch.

696,969. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Aug. 16, 1901. To prevent the circuit breaker from tripping when the circuit is first closed to start a motor without a rheostat, the circuit breaker is provided with means for putting the calibrating spring under increased tension during the moment of closing the circuit.

697,001. INSULATOR; W. H. Nichols, Bennington, Vt. App. filed Dec. 6, 1901. A knob-insulator in two similar parts, between which the wire is clamped, either part being adapted as the base.

697,002. COMBINATION TELEPHONE INSTRUMENTS; J. G. Nolen, Chicago, Ill. App. filed Aug. 7, 1901. (See page 688.)

697,007. CONTROLLING ARC LAMPS; E. Oxley, Brooklyn, N. Y. App. filed Aug. 25, 1900. (See Current News and Notes.)



697,267.—Automatic Electric Controller.

697,009. ELECTRIC TELEPHONE SYSTEM; W. E. Pembleton, Wittenberg, Wis. App. filed Dec. 24, 1900. (See Current News and Notes.)

697,012. CONTROLLER FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 8, 1898. In a controller of the separately actuated contact type, a contact for connecting the motors in series, another, for connecting the motors in parallel, and a mechanical connection between the contacts, whereby either one is caused to move to its open position, when the other is moved to its closed position.

697,013. ELECTRIC RAILWAY; William B. Potter, Schenectady, N. Y. App. filed Dec. 20, 1900. Details of a stud for a surface contact railway system, providing for the easy removal of the cap for renewal or access to the electrical connection.

697,016. STARTING DEVICE FOR ELECTRIC MOTORS; Robert H. Read, Schenectady, N. Y. App. filed Nov. 29, 1901, To obviate the motor circuit-breaker being tripped, it is short-circuited by the motor starting switch until the motor gets up speeed.

697,035. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 19, 1901. (See Current News and Notes.)

697,051. JUNCTION BOX COUPLING; M. F. Whiton, Hingham, Mass. App. filed Aug. 28, 1901. A locking device is inserted between the end of the conduit and the box.

697,052. JUNCTION BOX; M. F. Whiton, Hingham, Mass. App. filed Aug. 31, 1901. Sheet metal caps are fixed into the openings and adapted to be broken out to admit the end of the conduit.

697,057. REGULATION OF DYNAMO ELECTRIC MACHINES; T. W. Williams, Schenectady, N. Y. App. filed Dec. 4, 1900. (See Current News and Notes.)

697,065. APPARATUS FOR THE TRANSMISSION OF SIGNALS; C. E. Beach, Binghamton, N. Y. App. filed Apr. 6, 1896. One of the claims defines the invention as follows:

A general circuit, a series of separately insulated contacts connected to one side of said circuit, a magnetically controlled selector to successively connect the other side of the general circuit to the contacts, a magnetically-controlled transmitter, an auxiliary circuit jointly controlled by the selector and said transmitter, a shunt around the selector in the general circuit, and a mechanically-retarded relay controlling said shunt and operated by the auxiliary circuit.

697,077. ELECTRIC ARC LAMP; J. Eberhardt, Chicago, Ill. App. filed Aug. 13, 1901. A clutch consisting of a frame carrying a pivoted gripping dog on one side and a roller on the opposite side, and a stationary part against which the roller bears and which is located between the roller and an opening in the frame.

697,123. MEANS FOR TRANSMITTING ELECTRICAL ENERGY; J. E. Woodbridge, Schenectady, N. Y. App. filed Sept. 20, 1901. (See Current News and Notes.)

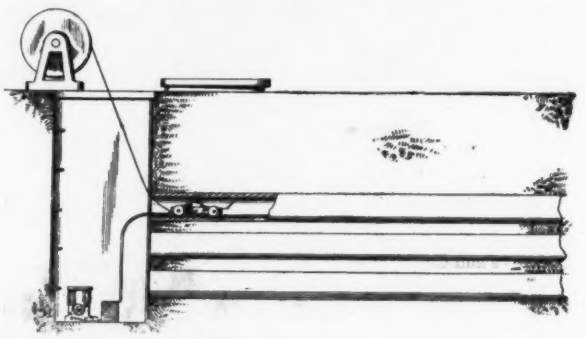
697,132. ELECTRIC CONTROLLER; F. E. Case, Schenectady, N. Y. App. filed July 16, 1900. Means for producing a magnetic field in a direction at right angles to the direction of motion of the moving contact and perpendicular to the face along which contact is made, a blow-cut chamber adjacent to each of the fixed contacts and having an opening for the reception of the arc and a closed wall opposite the opening in the direction of travel of the arc. The whole arrangement is for the purpose of disrupting the arc.

697,144. CIRCUIT CONTROLLER; Edward M. Hewlett, Schenectady, N. Y. App. filed Sept. 9, 1901. A solenoidal core has a free movement over part of its course and is retarded over the remainder of its course by the action of a spring. In the case of an overload the first part of the course is traversed, at the end of which a contact is made which lights a warning lamp. Should the overload become abnormal, the second part of the course is traversed against the action of the spring referred to, and at the end contact is made which trips the circuit-breaker. The specifications describe how the same principle may be applied to a reverse current relay.

697,157. ELECTROLYTIC APPARATUS; F. McDonald, Rumford Falls, Me. App. filed May 20, 1901. Details.

697,161. CONTROLLING ELECTRIC LAMPS; E. Oxley, Brooklyn, N. Y. App. filed Aug. 25, 1900. (See Current News and Notes.)

697,163. ELECTRIC SWITCH; G. B. Painter, Schenectady, N. Y. App. filed May 31, 1901. The cross-head on the key spindle of a lamp socket is fitted thereto with lost motion, but in such a manner as to be rotated by the spindle, thus affording good contact across the terminals.



697,315.—Means for Inserting Cords, etc., into Underground Conduits.

697,192. METHOD OF CHARGING ACCUMULATORS; R. E. Ball, New York, N. Y. App. filed July 1, 1901. (See Current News and Notes.)

697,193. MEANS FOR CHARGING ACCUMULATORS; R. E. Ball, New York, N. Y. App. filed July 1, 1901. (See Current News and Notes.)

697,219. ELECTRIC CIRCUIT PROTECTOR; C. A. Rolfe, Chicago, Ill. App. filed Dec. 3, 1900. Details.

697,267. AUTOMATIC ELECTRIC CONTROLLER; A. McGary and P. Mellinger, Lagrange, Ill. App. filed May 25, 1901. In a plant where the dynamo is driven from a car axle, a variable resistance is arranged for introduction in the field circuit and a traveling bar which controls the resistance is actuated by the axle and a magnet in the main circuit, opposing each other, so that variations of speed will automatically change the resistance in circuit.

697,273. AUTOMATIC SAFETY SWITCH FOR ELECTRIC CIRCUITS; O. L. Plumtree, Chicago, Ill. App. filed Jan. 18, 1901. A snap-switch is controlled by a spring and a magnet in the main circuit opposing each other.

697,277. SIGNALING SYSTEM FOR SINGLE TRACK RAILWAYS; W. W. Salmon, Chicago, Ill. App. filed July 21, 1894. Details.

697,315. MEANS FOR INSERTING CORDS OR THE LIKE INTO UNDERGROUND CONDUITS; L. J. Bergdoll, Philadelphia, Pa. App. filed Jan. 17, 1902. A small motor car traverses the conduit and drags after it a cord or cable.

697,351. ORE SEPARATOR; J. M. McClave, F. H. Kirby, E. R. Cumbe, Denver, Col. App. filed May 10, 1901. The separator comprises opposing electro-magnets, a drum of non-magnetic material moving between the poles of the magnets, a belt carrying the ore also moving between the magnets and bands of magnetic material supported by the drum, which cooperate with projections from the pole piece of one magnet to deflect magnetic portions of the ore.